Steel Pole and Tower Transmission Lines—Construction Features and Costs

BY W. L. CADWALLADER, ELECTRICAL ENGINEER R. D. COOMBS & CO., NEW YORK CITY.

WHILE wood pole construction is yet considered economical under certain conditions for medium voltage transmission lines, the tendency among most of the large transmission companies of this country is to install permanent types of supports for all lines. There are three general types of steel supporting structures in use today—the wide base tower, the narrow base pole, and the flexible (A) frame. Of these, the former was probably the first to be used in this country, and is still found more extensively than the other two.

There is a certain field within which both of these types posesses a marked advantage over the others, and another which is debatable ground, where the various arguments for and against each type must be carefully weighed before a fair decision can be made as to which is the most desirable. For example, in our sparsely settled states, where land is cheap, and the line is difficult of access, the wide base knocked down tower has the advantage. The individual pieces of the structure are light and can be transported over rough mountain trails, where the heavy section of a riveted pole might cause trouble. Then again, in rough country, spans are frequently lengthened so that a jump is made from one summit to the next over an entire valley, producing loads upon the supporting structures, which in a narrow base pole would necessitate the use of excessively large leg sections, or the installation of side guys. On the other hand, on curb lines of existing or proposed streets and on narrow rights of way, the use of a wide base tower is impracticable. For light lines both the (A) frame and the pole are admirably suited, the former being perhaps slightly cheaper, and the latter providing somewhat better construction.

PHYSICAL CHARACTERISTICS OF STEEL POLES AND TOWERS.

Let us turn to the physical characteristics of the three types. Towers are generally square, with an angle for each leg, although some have been constructed with legs of galvanized pipe. The width of the ground is usually from ten to twenty feet, and the most familiar form of structure

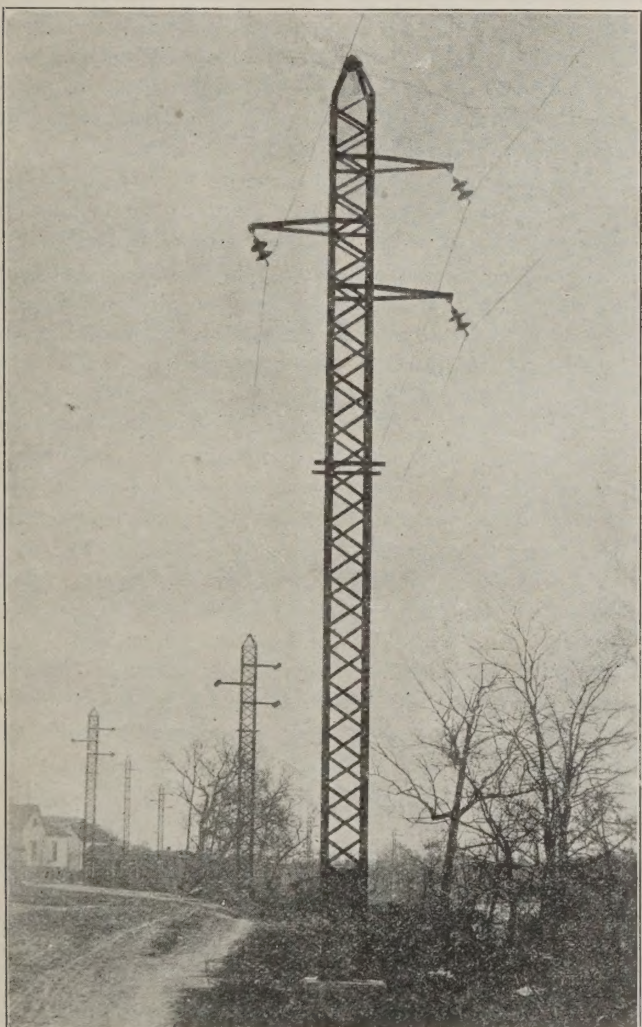


FIG. 1. SINGLE CIRCUIT STEEL POLE TRANSMISSION LINE.

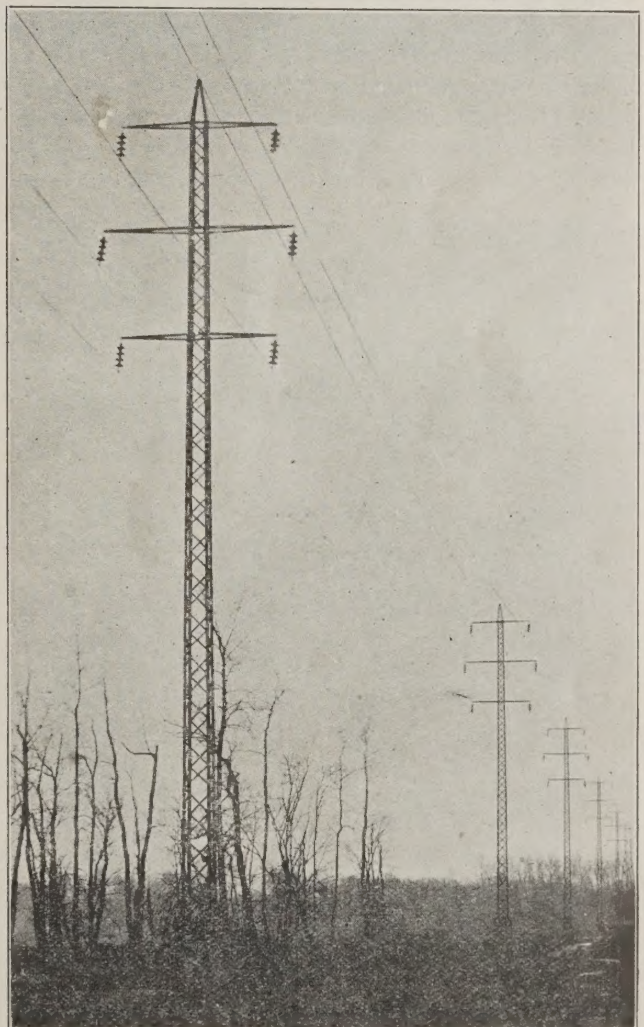


FIG. 2. DOUBLE CIRCUIT STEEL POLE TRANSMISSION LINE.

slopes in all faces to a width of from two to four feet at the top. The diagonals and struts composing the bracing serve not only to carry the horizontal shear down to the foundation but also to stiffen the legs, which, under compressive stresses, act as columns supported at the panel points. This type is usually galvanized, shipped knocked down, and bolted together in the field.

Poles are generally square with a single angle in each corner, and are usually shop riveted and shipped in one or more sections as desired. The width is variable depending both on the strength required and upon local conditions. The length of leg between diagonal intersections is very much shorter than in the case of the tower and its ultimate strength in compression is thereby increased. Since in most cases steel poles and towers fail by buckling of the leg rather than in tension, the greater unit strength of the pole leg compensates, at least partially, for the fact that with equal loads at the top, the wider structure will have the lower stresses.

The (A) frames as a rule consist of two channels connected by bracing. The width perpendicular to the direction of the line varies from two to eight feet, and parallel to the line is equal to the size of the channel forming the leg. Occasionally two angles connected by bars or angles in the form of a channel have been used, with the view of getting a greater width parallel to the wires without the use of excessively large channels, but their economy is questionable.

Obviously, the strength of the (A) frame for loads across the line can be made comparable to that of a pole or tower, while for longitudinal loads, its strength is very small. Owing to its extreme flexibility in this direction, however, an unbalanced longitudinal pull at the top, produced for example by a broken wire, causes a deflection in the direction of the pull. This decreases the stresses in the wires upon this side of the frame, and increases the stresses in those upon the other side until a position is reached where equilibrium is again attained. As this deflection extends back in a lessening degree through the frames on each side of the break, an anchor structure should be installed about every fifth frame, to localize such disturbances, and to prevent the entire line, under too severe conditions from going down like a house of cards.

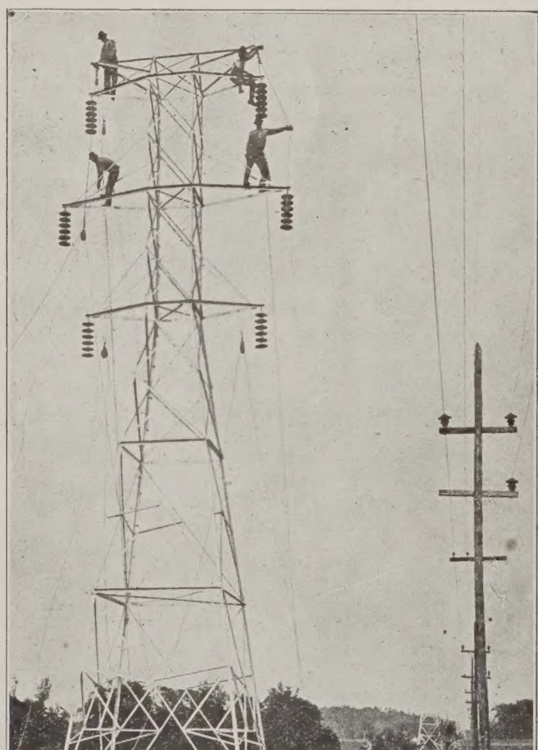


Fig. 3. The Double Circuit Steel Tower Construction Used by Alabama Power Co., and Temporary Wood Pole Line.

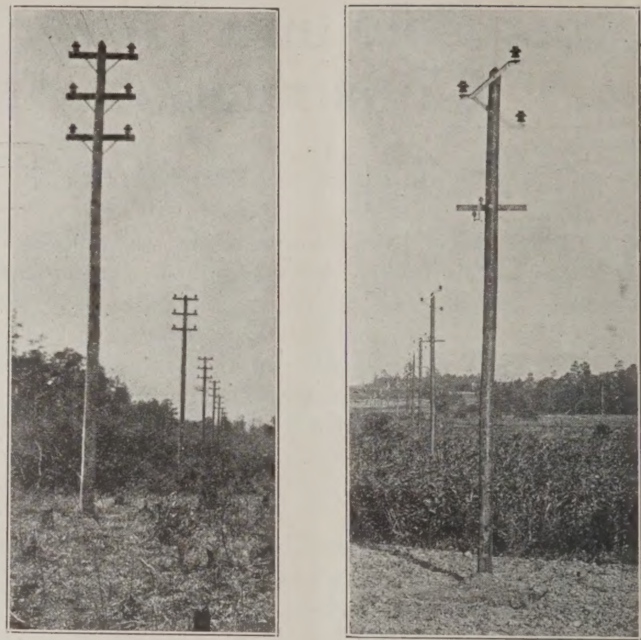


Fig. 4. Types of Wood Pole Line Construction.

The characteristics of the tower is its stiffness, and of the (A) frame its flexibility, while the pole combines the characteristics of both. That is, if properly designed, it will be able to resist all ordinary loads without noticeable deflection, while under extreme broken wire conditions, it will bend sufficiently to reduce this load to a considerable extent, and will possess sufficient strength to carry the remaining unbalanced load safely.

A comparison of the riveted steel pole with the wide base tower invites many points of discussion. The wider structure can be made stronger, with a given weight of metal than the pole, permitting the use of slightly longer spans. Also where transportation is a serious problem, the advantage in handling relatively light pieces is obvious. Among the points in favor of the riveted pole, structurally, is the fact that it is assembled in the shop where work can be done more efficiently and economically than out along the transmission line, and that it is riveted instead of bolted. Also it does not possess long thin members which have large ratios of length to radius of gyration, and which can easily become bent in handling, thereby suffering serious reduction in strength. If galvanizing is deemed desirable, a galvanized stub section can be used with a riveted and painted top section of pole, thereby combining the advantages of the riveted structure, with the protection of the galvanizing at the point most needed, namely at the ground level.

FEATURES OF CONSTRUCTION WITH STEEL POLES.

From the point of view of the construction superintendent, the pole possesses many admirable features. Primarily

stands ease in erection. It arrives at the site completely assembled and ready for erection, with only the cross arms to be bolted on with two sections to be bolted together where too long for shipment as a whole, or where separate stub sections are used. It can then be swung into position and dropped into its foundation by methods similar to those employed in erecting wooden poles. Only one foundation hole is needed, but slightly larger than would be required by a wooden pole, instead of the four holes called for by the wide base tower. These few and comparatively simple operations are in direct contrast to the various steps in the erection of a tower, with its many pieces to be handled and bolted together, with the many added difficulties in setting foundation stubs accurately, and with its more ungainly mass to be swung into place. The size of the field organization is much smaller, and yet with only a fairly efficient corps, erection of the poles should proceed at the rate of a mile a day.

From the point of appearance, the pole line with its slender and compact outline compares very favorably with the tower line. It is not so noticeable, which at times is a distinct advantage and it can be run along curb lines or along restricted rights of way, and does not seem to meet with so much opposition by land owners. The writer can recall many instances in which a power company in endeavoring to run a line across private property has met with serious opposition by some owner who has refused absolutely to permit the installation of a tower on his land,

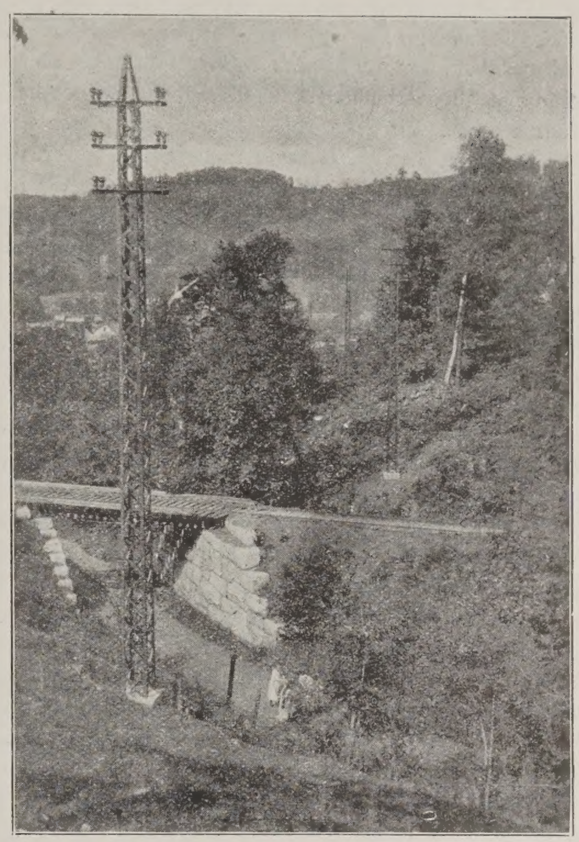


FIG. 6. DOUBLE CIRCUIT STEEL POLE LINE WITH PIN TYPE INSULATORS SHOWING CONSTRUCTION FOR RAILROAD CROSSING.

but when shown a photograph or drawing of a narrow base pole, has withdrawn his opposition at once.

While for a heavy power line, the advantage in the use of steel supporting structures is generally admitted, a similar advantage in the case of a lighter line does not seem to be so clearly understood. Here the wires are frequently smaller, so that spans of 500 feet or more, where the wide base tower is most economical, can not be used without giving a large sag to the wires. This in turn necessitates the use of excessively high poles or towers, and, if two wires lie in the same horizontal plane, a large horizontal separation is called for to prevent their swinging together.

STEEL POLES VS WOOD POLES.

The possibilities in the use of the steel pole for the lighter line, merit consideration. Spans of moderate length can be used where the sag will not be too great, and where a single steel pole will take the place of three or four wooden poles. It is true that the former will cost more than one or even three or four wooden poles, but there are many other points of economy in the longer span line, which will reduce this difference. The cost of the insulators, pins and ties, and of their erection, as well as the cost of foundations and pole rights, will be reduced in proportion to the number of poles saved, Erection should be cheaper, since although an individual steel pole will cost slightly more to erect, there are considerably fewer per mile. Since the chief source of electrical trouble in the line is at the insulator, the fewer number of these per mile should greatly decrease the chances of trouble, and interruption of service.

There remains the item of maintenance cost, where clearly the economy is on the side of the steel pole. Neg-

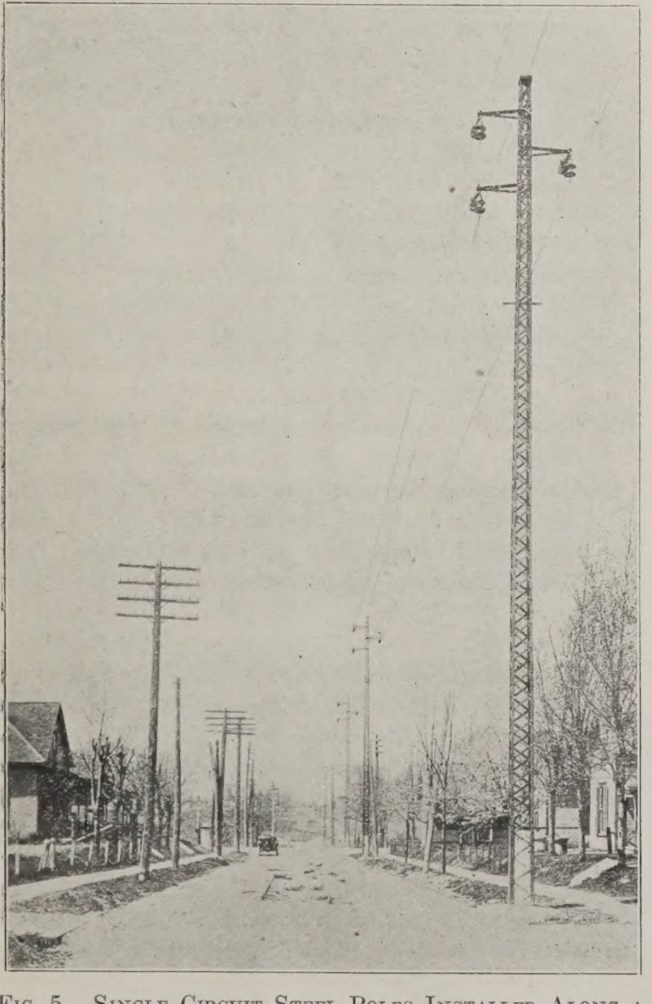


FIG. 5. SINGLE CIRCUIT STEEL POLES INSTALLED ALONG A CURB LINE.

lecting maintenance of the line and comparing only the supporting structures, the steel pole requires only a coat of good paint every few years. This, let it be remarked, should not be overlooked or neglected, for while the individual sections are as a rule, thicker and better able to resist corrosion than are those of a galvanized tower, proper protection by the paint will add many years to the life of the pole. Wooden poles and cross arms on the other hand require close observation for signs of decay and mechanical failure, and even at best their life is comparatively short. Replacement is an expensive operation, involving the purchase of new material at probably advanced prices, the erection of the new pole without interfering with service, and the removal of the old pole.

There are other considerations beside cost, which might be mentioned. The steel line is more free from interruptions to service electrically, because of fewer points where trouble can occur, and mechanically because the individual structures are stronger and the line is as a rule designed with more regard to the probable loads it must carry. This point can well be made use of in obtaining customers to whom interference with service is a serious matter. Also the steel line is likely to receive far more favorable treatment at the hands of state and municipal authtorities, and from railroad and telephone companies, with which it comes into proximity.

Comparative costs which may be accurate for a given set of conditions may give very erroneous conclusions, if applied elsewhere under widely different conditions. The following extract from an estimate prepared by R. D. Coombs & Co. gives a comparison between the cost of a short span wood pole line, and a long span steel pole line. The line consisted of one 3/8 inch steel ground wire, three 33000 volt No. 2 copper conductors and two No. 10 copper clad telephone wires. For the wood pole construction, 35 foot poles with spans of 120 feet—44 poles per mile—were considered using metal cross arms and pin type insulators. The line ran through rolling country and was fairly easy of access for construction and inspection.

COST OF WOODEN POLE LINE.

			Per Mile.
Poles 35 feet long, 7 inch tops at $5.00			$220.
Cross arms, galvanized			167.
Telephone brackets			5.
Pole steps and hardware	at $0.75 per pole		33.
Framing and trimming	at 0.50 per pole		22.
Creosoting butts	at 0.20 per pole		9.
			$456.
Hauling			44.
Digging holes	at $1.20	$ 53.	
Bog shoes or braces		8.	
Setting poles	at $1.80	79.	
		$140.	$140.
Guying			30.
			$670.

WIRES AND LINE MATERIAL.

1 ground wire	$ 54.		
3 conductors	544.		
2 telephone wires	50		
	$648.		
Ties	5.		
Soldering materials	5.		
33000 V. Insulators	66.		
Telephone Insulators	5.		
Pins	50.		
Ground wire connections	16.		
Stringing wires	85.		
	$880.		$880.
Clearing and trimming			10.
Miscellaneous materials and tools			15.
Right of Way	at $5.00		220.
Supervision, engineering and general expense			100.
Contingencies and incidentals			30.

Total per mile of line $1,925.

COST OF STEEL POLE LINE.

For the steel pole construction, 400 foot spans—13 poles per mile—with 3-disc suspension insulators were considered.

		Per Mile
Poles and arms	at $53.00	$698.
Hauling	at 2.25	29.
Digging holes	1.50	20.
Concrete at corners		40.
Crushed stone		6.
Erection	at $ 2.25	29.
Guying		30.
Painting		20.
Miscellaneous		7.
		$870.

WIRES AND LINE MATERIAL.

1 ground wire	$ 54.	
3 conductors	544.	
2 telephone wires	50.	
Soldering materials	5.	
Insulators and clamps	137.	
Telephone insulators	5.	
Stringing wires	100.	
Miscellaneous	15.	
	$910.	$910.
Clearing and trimming		10.
Miscellaneous materials and tools		20.
Rights of Way at $7.00		90.
Supervision, engineering and general expense		100.
Contingencies and miscellaneous		30.

Total per mile of line $2030.

These figures do not include special structures at crossings, or where greater height is required. They show very little difference in first cost between the two types of construction, but when ultimate cost is considered, which would include maintenance and allowance for depreciation, they show a decided saving in favor of the steel line.

In conclusion, it should be recalled that just as a single weak link in a chain determines the strength of the entire chain, so will a poorly built transmission line reduce the efficiency of a plant, which in all other respects is constructed and managed capably. Good construction in the line, whether it is of wood or steel, will in the long run, be true economy.

Southern Water Powers and Their Part in the Development of the South

BY E. A. THORNWELL*.

THE rapid evolution of the South from an agricultural section to a combined agricultural and manufacturing section naturally lends considerable interest to the factors which promote industrial and manufacturing development. The three most important requirements for all manufacturing or industrial plants are, labor, transportation facilities and power supply.

Our early railroads were built along the ridges and the various industries necessarily followed the railroads locating at points convenient to transportation facilities and where labor was available. In this early stage of the South's development, the power question was a negligible one as the forests abounded in fuel so that wood was used for the production of steam power. As the forests gradually diminished, coal superseded wood as fuel and the development of our coal mines began. Even in the early stages of manufacture the possibilities of water power were recognized but as these powers were located at places away from transportation facilities and there was then no way to transmit this power to the manufacturing plants, the bulk of water power remained unused.

It may be interesting to note that the city of Augusta, Ga., was probably the first place in the South to recognize the possibility of using water power on a large scale and in 1847 this city arranged to bring the force of the Savannah River to Augusta. This was done by building a canal through the city and power is still sold from this canal. Each consumer installed his own equipment, simply renting water from the city at so much per horsepower per year. This is probably the last canal of its type ever constructed for such a purpose, as electricity has been found to be a much more convenient method of conveying power and in 1914 a hydro-electric plant was put in operation on the same river 18 miles above Augusta which supplies that city with approximately 18,000 electrical horsepower.

In 1880-1885 electricity was beginning to be used for lighting densely populated districts but at that time even the great dreamers never conceived of the possibility of applying it on the scale we use it today. For instance, nowadays many cities use more power for industrial work than for lighting and in some instances the current consumed in sign lighting alone exceeds that required for the total street lighting.

At this time only direct current apparatus had been developed, which on account of the necessarily low voltage limited its application to very restricted areas. During the eighties (1886 being the date of actual operation) the alternating current system began to be developed and this system led directly to the development of our water powers, the transformer being the last link that made these developments possible.

Less than a quarter of a century ago, in 1890, the first water power development using electrical transmission was installed at Telluride, Col., using 3,000 volts as the transmission voltage. No transformers were used, the generator voltage being sent directly on the line.

The South was not far behind, for in 1895 there was put in operation at Anderson, S. C., a transmission system operating at 5,500 volts, quite a high voltage system at that time to be sure. Three years later the highest voltage generator in America was installed near Anderson at Portman Shoals on the Seneca River about 10 miles from Anderson. There were two generators of 1,200 Kw. each wound for 11,000 volts which was also the transmission voltage. This plant was the beginning of a system later controlled by the Savannah River Power Co. and is now a part of the Southern Power Company's great system. This plant was built only 16 years ago or a little more than one and a half decades, which when compared with our present developments gives some idea of the rapidity with which this line of development has moved.

The value of Southern water powers was beginning to be recognized at this time as is shown by the State Geologist's report of 1896, in which mention is made of 22 water falls whose power was irrecovably going to waste. In this report Mr. B. M. Hall, special assistant, says:

"Very few of the large water powers of Georgia are utilized. This is a fact not from the lack of energy and enterprise on the part of the people of the state, but because their energy has heretofore been directed mainly to agriculture and commerce and not to manufacturing. But a rapid change is taking place in this respect, and it is for the betterment of our future that this, the dawn of the age of electricty has found us with undeveloped powers ready to receive the latest and best machinery, without the loss and expense of taking out old machinery to make room for it; or worse still the necessity of running antiquated machinery at a great loss when it is brought into competition with the latest improvements."

Of the 22 powers Mr. Hall names as going to waste, 8 have since been developed and are adding to the wealth and conservatism of the resources of the state. In the States of North Carolina, South Carolina, Georgia, Florida, Alabama and Tennessee today, according to the most reliable figures available, there is in actual operation 462,940 Kw. as follows: North Carolina, 47,330 Kw.; South Carolina, 131,150 Kw.; Georgia, 147,010 Kw.; Florida, 3,300 Kw.; Alabama, 64,350 Kw.; and Tennessee, 69,800 Kw.

Thus in 16 years from 1898 to 1914, we have seen an increase from 2,400 Kw. to 462,940 Kw. or an increase of 19,200 per cent. Were it possible for a like development to go forward at the same rate for the next 16 years, we would have in 1930, 88,301,026 K.w. or 117,734,700 horsepower. This is of course impossible but the figures are given to show the remarkable development that has gone forth in the last few years.

Mr. George Westinghouse in his paper before the Southern Commercial Congress in Atlanta in 1911 estimated the total available horsepower in our streams at 5,000,000 to 7,000,000 horsepower, which if fully developed on a pri-

*Electrical Engineer with Westinghouse Electric and Mfg. Co., and manager of Railway and Lighting Department of Atlanta office.

mary basis would save annually 25,000,000 tons of coal on a 10 hour per day basis. At the same meeting of this congress Mr. W. P. Lay of Alabama made the statement that it would require 80 per cent of the coal mined in Alabama annually to produce the amount of power going to waste in the Alabama rivers. The enormity of this waste is only appreciated when we find that the coal mined in this state annually is 14,000,000 tons which means that in the waste power there is an equivalent of 11,201,000 tons.

Not only have our Southern hydro-electric possibilities been wisely developed, but a further opportunity of securing maximum efficiency has been grasped in tying together the powers of the various streams through transmission systems. The rainfall on different rivers varies in such a way that high water or low water may severely affect the plants on one stream and not so seriously interfere with those on another, making this combination particularly desirable.

In this great system the powers of the following rivers are tied together: The Ocoee, through the Tennessee Power Co.; the Tennessee, through the Chattanooga and Tennessee River Power Co.; the Chattahoochee, through the Georgia Railway and Power Co. and the Columbus Power Company; the Tallulah, through the Georgia Railway and Power Company; the Ocmulgee, through the Central Georgia Power Company; the Catawba, Broad, Saluda, Savannah and Seneca, through the Southern Power Company and its subsidiary companies; the Yadkin, Cape Fear, and Neuse, through the Carolina Light & Power Company. Thus from both sides of the Appalachians we have connected thirteen different rivers in five different states with the probability that four more will be added in the near future.

SOUTHERN TRANSMISSION SYSTEMS.

The transmission system for connecting these powers together extends from Henderson, N. C., on the north, west to Nashville, Tenn., a distance of approximately 500 miles, and to Columbus, Ga., on the south, west an equal distance. Steel tower construction is largely used throughout on these lines, though some pole lines are still in use, the prevailing voltage being 110,000 star connected or 66,000 volts delta conected with tie in transformer stations wherever the different circuits have different voltages.

Beginning in northeastern North Carolina, the Carolina Light & Power Co. operates 188 miles of transmission line with hydro-electric plants of 3,300 horsepower on the Cape Fear River and 530 horsepower on the Neuse River with steam plants of 5,000 horsepower at Raleigh, 950 horsepower at Goldsboro, and 300 horsepower at Henderson, also 9 substations, aggregating 23,000 horsepower. This company also controls the Yadkin River Power Co. operating 185 miles of transmission line and 49 miles of distributing line with a hydro-electric plant of 32,000 horsepower on the Yadkin River and 5 substations aggregating 4,100 horsepower. This company ties in with the Southern Power Co. near Durham, N. C.

The Southern Power Co., operates 1,550 miles of transmission line with hydro-electric plants of 30,000 horsepower at Great Falls on the Catawba, 30,000 at Rocky Creek on the Catawba, 22,500 at Ninety-nine Islands, on the Catawba, 6,740 at Catawba Falls on the Catawba, 30,000 horsepower at Look-out Shoals on the Catawba (now being completed), 3,500 horsepower on the Saluda, and steam plants of 10,000 horsepower each at Greenville, Mt. Holly and Greensboro and 2,500 horsepower at Charlotte; also 103 substations aggregating 241,162 Kw. In addition to the above this company controls the Southern Public Utilities Company which operates plants on the Savannah and Seneca Rivers with steam plants at various points. The lines of the Southern Power Co. tie in with the Georgia Railway and Power Co. at Tallulah Falls, Ga.

The Georgia Railway & Power Co. operate 242 miles of transmission and 208 miles of distributing line with hydro-electric plants of 62,000 horsepower at Tallulah Falls on the Tallulah River; 13,000 horsepower at Bull Sluice on the Chattahoochee River; 2,200 Kw. at Dunlap on the Chattahoochee River, with steam plants at Atlanta of 21,500 Kw. and six substations with a temporary rating aggregating 46,500 Kw. and an ultimate rating of 114,000 Kw.

Going north this company ties in with the Tennessee Power Company at Rome, Ga., and also ties in with the Central Georgia Power Co. at Atlanta and the Columbus Power Co. at Newnan, Ga.

The Tennesse Power Co. operates 453 miles of transmission with 485 more proposed; with two hydro-electric plants of 50,000 horsepower on the Ocoee River, steam plants at Chattanooga, Nashville, Cleveland and other points and 15 substations aggregating approximately 55,000 Kw. Connected with this company at Chattanooga is the Chattanooga and Tennessee River Power Co. operating 20 miles of transmission line with a hydro-electric plant of 37,500 horsepower on the Tennessee River at Hales Bar, with one substation at Chattanooga of approximately 6,000 Kw. Arrangements have recently been made whereby a part of the output of this company will be sold to the Tennessee Power Co. being delivered at 110,000 volts at Hales Bar.

Returning to Georgia, the Central Georgia Power Co. operates 154 miles of transmission line, with one hydro-electric plant near Jackson on the Ocmulgee River of 24,000 horsepower, with steam plants at Macon, also 8 substations aggregating 25,500 Kw.

The Columbus Power Co. operates 140 miles of transmission, having 3 hydro-electric plants of 54,000 horsepower on the Chattahoochee River, with a steam plant at Columbus, also four main substations aggregating 10,000 Kw. with various smaller stations.

While the Alabama Power Co. is not connected to this system, there would only be required approximately 50 miles of transmission to reach this company at Gadsden. This is the latest of the great systems to be put into operation in the South, its plant at Lock 12 on the Coosa River just being completed, so a short description of its properties is given. This company operates 186 miles of transmission line, having hydro-electric plants of 70,000 horsepower on the Coosa and Choccolocca Rivers, with steam plants at Gadsden of 25,000 Kw., also four main substations aggregating 45,300 Kw. at present. The generators in the station at Lock 12 are the largest yet installed in the South, having a rating af 13,500 Kva., and being connected to vertical water wheels with a rating of 17,500 horsepower each. Current is generated at 6600 volts and stepped up to 110,000 volts, each generator having its own bank of transformers. All of the substations are of the outdoor type, and all of the equipment represents the latest design in water power work.

While the plants of the various systems as mentioned above are interconnected, arrangements are only made for the exchange of a limited amount of power in each instance. This is done on the basis of the amount of power each company requires or can spare as the case may be and the relations of the various companies to each other is only that of a public utility and a power customer, as the management and ownership is different in each case.

A glance at the work being done by the various water power companies is indicative of the part their developments have taken in the industrial development of the South.

In the cotton mill industry we find from United States government statistics the electrical horsepower installed in the following states to be, Alabama, 6,000; Georgia, 20,000; North Carolina, 70,000; South Carolina, 80,000; Tennessee, 6,500; a total of 182,500.

Street railway systems are now operated by water power in the cities of Birmingham, Ala., Montgomery, Ala., Gadsdens, Ala., Anniston, Ala., Rome, Ga., Columbus, Ga., Atlanta, Ga., Macon, Ga., Augusta, Ga., Athens, Ga., Gainesville, Ga., Chattanooga, Tenn., Knoxville, Tenn. Nashville, Tenn., Columbia, S. C., Greenville, S. C., Spartanburg, S. C., Rock Hill, S. C., Charlotte, N. C., Goldsboro, N. C., Greensboro, N. C., Raleigh, N. C., Salisbury, N. C., Winston-Salem, N. C. This list shows that practically all cities above the fall line (which makes a line down through Goldsboro, N. C., Sumter, S. C., Augusta, Ga., Macon, Ga., Columbus, Ga., Montgomery, Ala., then going in a northwest direction through Mississippi) are operated by water power, the few exceptions being those too distant or too small to justify the extension of transmission lines to supply them.

In addition power is supplied to the inter-urban electric lines, Atlanta to Marietta; Atlanta to Stone Mountain; Nashville to Franklin; Nashville to Gallatin, and to the complete Piedmont and Northern system in the Carolina's. This inter-urban which is a direct result of the development of the powers in those states, now has in operation 126 miles of electric railway, with plans for future extensions.

Also directly attributable to these powers are the mammoth plants of the Southern Aluminum Co. at Whitney, N. C., and the Aluminum Co. of America near Maryville, Tenn. The aluminum industry, like certain other industries, requires large amounts of cheap electric power, and these plants which water resources have already brought are only a forerunner of other industries that will come to add to the wealth and development of the South.

A few of the other industries which are peculiarly adapted to the South are: Textile mills, fertliizer works, cement plants, coal, iron and gold mining plants, ore reduction plants, iron and steel mills, agricultural implements works, canning factories furniture manufacturers, lumber plants, paper mills, shoes and leather factories, and oil refineries, in all of which industries electric power increases production and is superior to any other.

This power has the advantage of a very constant speed allowing higher speed hence increased production in many plants; extreme flexibility allowing any part of a plant to be operated independent of any other, also allowing any plant to be designed entirely for manufacturing convenience without consideration of power arrangement; cleanliness with better light and better working conditions; decreased fire hazard, hence decreased insurance; and many others which stamp electric power the ideal one. As increased wealth is produced in our industries, equal comforts and luxuries will follow in our homes accomplished through this same agent.

The ultimate value of the power of water through its electrical transformation in a section so richly blessed as the South could only be depicted by a Jules Verne, but the development of our natural resources through increased manufacturing and transportation facilities attributable to the power of water will add great wealth, not so much to those who harness these waters, but to the people of the South who take advantage of the opportunities thus presented.

The writer has taken much of the data under the heading of Southern transmission systems from an article appearing in the May 30, 1914, issue of Electrical World, and acknowledgement is hereby made for such.

Electric Signs at Hong Kong.

According to a recent issue of the *Consular and Trade Reports,* the small boom in the use of electric appliances in Hongkong which has been experienced for the past year is giving rise to the use of electric signs of more or less display qualities in the city, though so far the extent of such use is limited and the variety of the signs employed is comparatively modest. Several of the larger Chinese business establishments, notably the Chinese department stores facing on the water front and the large Chinese restaurants along the water front and in the parts of the city given over to such establishments, are display signs of some size and importance, generally in the shape of Chinese characters. Moving signs in the colony so far are confined to alternate shows of color, appearing and disappearing, and other more simple forms of mechanical signs. They represent a big advance over ordinary Chinese signs and advertising signs in this part of the Far East generally, but are in no sense representative of modern mechanical sign advertising.

The use of such mechanical or other large signs is carefully restricted by the Hongkong government. A local ordinance prohibits the erection of any such sign, particularly a "sky sign," without a license from the government, which is withheld except under circumstances judged by the head of the police department in each case. In case of existing signs none can be used more than three years from January, 1913, or in case of the destruction of signs at present in use by storms or otherwise no sign can be reerected without further license. The object is to prohibit the use of all signs likely to spoil the general aspect of the landscape, which, in the case of Hongkong, is a serious matter, and it also is desirable to avoid danger from high signs badly mounted to resist typhoon and other storms common in this climate. With these restrictions in view, however, there is doubtless an increasing field for the sale of such modern advertising appliances. Merchants in Hongkong are commencing to adopt modern methods in their business, they are commencing the more attractive and modern display of their goods, and advanced sign and advertising methods are the natural accompaniment to the present movement. There are also a number of large shipping concerns likely to be good customers in such a movement. As a rule, Hongkong architecture lends itself fairly well to such displays, even with the limitations noted.

Materials for High Tension Transmission Line Construction

Information and Data Compiled from Standard Authorities.

WHEN an electrical engineer or a superintendent of construction is confronted with the problem of designing and writing specifications for a transmission line, there are three important considerations held prominently in view and largely determine the nature of such an installation. These are: 1.—The desirable efficiency of the line as a whole. 2.—Cost of the line completed. 3.—Material available for construction.

Item number 1 is largely limited by item number 2, while both items numbers 1 and 2 depend upon item number 3. With the present tendency to standardize equipment as far as possible, both from the standpoint of the operating company and the manufacturer, the consideration and use of available material is a matter of vital interest and economy. In what follows, therefore, no attempt will be made to give the methods and calculations used in the design of transmission lines, but rather to present some of the important considerations that have to do with the selection of standard transmission line material and at the same time show through illustrations the nature of this equipment in the types available and in use on existing lines.

Transmission Line Conductors.

The material used for transmission line conductors is hard-drawn copper with an ultimate tensile strength of about 60,000 pounds per square inch, aluminum with a tensile strength of about 28,000 pounds per square inch, and copper-clad steel with a tensile strength of about 100,000 pounds per square inch. All these metals are most used in cable form when larger than No. 6 B & S gage, since solid conductors for long spans tend to crystallize at the points of support, due to constant swinging in the wind. Solid wires are, however, used up to No. 00, which however, is about the practical limit.

For cables of equal length and resistance, the copper cable is about twice as heavy as an aluminum cable. Also for equivalent conductivity the aluminum conductor has 1.56 times the cross section of the copper conductor and thus presents a larger surface to the wind and for ice formation. The difference in cross sectional area for equal conductivity corresponds almost exactly to a change of two B & S gage numbers, as shown in accompanying table of wire data.

In comparing prices of aluminum and copper conductors, the proper basis is not the price per pound, but equal conductivity. For equal conductivity, aluminum is only 46.9 as heavy as copper as stated so that if copper wire costs 15 cents per pound, the price that can be paid for aluminum will be (15 $\times$ 2.13) or 31.9 cents per pound. Since aluminum saves about 53 per cent in weight of conductor, it lessens strains on towers, holes, insulator pins, etc., and under certain conditions is a favorable factor in reducing transmission line costs. Aluminum, however, has a draw-back not met with in copper, in that it has a high co-efficiency of expansion and sags more in summer and less in winter than copper, making it important to consider the time of year when the conductor is strung, and calling for special attention in calculating the amount of sag.

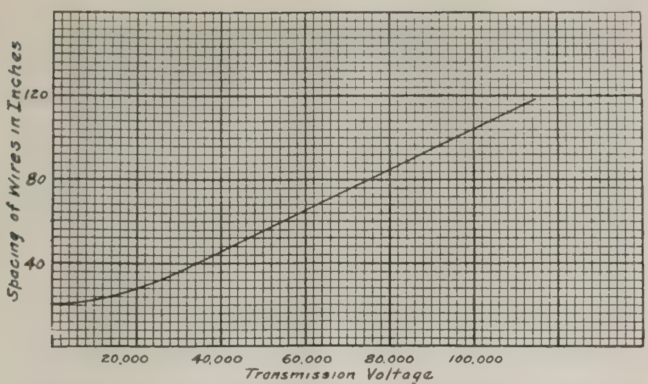
The size of conductor for a transmission line depends upon the load to be transmitted, the voltage to be used, the permissible loss of energy in transmission, the frequency of the system, the spacing of the wires on the cross-arms, and the length of the line. The voltage to be used, besides entering into the consideration of wire size, also largely determines the nature of insulators and supporting structures.

The best voltage for a system, as far as a transmission line is concerned, is the highest that can be economically produced. This is on account of the fact that the laws governing the alternating current circuit, show that the higher the voltage, the smaller the current for a given amount of power. Thus a small current on the line means that the size of conductor can be reduced until the mechanical strength of the wire used is the controlling factor. The use of high voltages reduces the line drop, the losses in transmission, and gives better regulation than lower voltages, yet calls for greater expense both in cost of material and construction. The selection of voltage, therefore, is an engineering consideration largely controlled by particular conditions and engineering judgment.

The arrangement and spacing of conductors on poles and towers is also influenced by the voltage, and the length of the span. The best distance is just that which will allow lines to whip in the wind without touching, and be sufficiently far apart at the supports so as to prevent flashing during line disturbances. The increase in spacing in-

DATA ON STRANDED COPPER AND ALUMINUM CABLE.

B & S Gage or Cir Mils		Approx Diam in Inch		No. of Strands		Resistance per 1000 Ft. at 77° F	Weight—Lbs per 1000 Ft.	
Copper—(97%) Equivalent	Aluminum 61%	Copper	Alum.	Cu.	Al.		Copper	Aluminum
1000000	1590000	1.153	1.437	61	61	0.0111	3090	1462
900000	1431000	1.094	1.375	61	61	.0124	2780	1317
800000	1272000	1.031	1.281	61	61	.0139	2470	1171
700000	1113000	.964	1.203	61	37	.0159	2160	1025
600000	954000	.833	1.109	61	37	.0186	1850	877
500000	795000	.815	1.015	37	37	.0223	1540	732
400000	636000	.728	.906	37	37	.0278	1240	585
300000	477000	.634	.781	37	19	.0371	926	439
250000	397500	.575	.718	37	19	.0444	772	365
0000	336420	.528	.656	19	7	.0525	653	310.2
000	266800	.470	.578	19	7	.0662	518	245.7
00	211950	.419	.515	19	7	.0836	411	195.0
0	167800	.375	.468	19	7	.105*	326	155.0
1	133220	.333	.406	19	7	.133	258	122.6
2	105530	.292	.375	7	7	.167	205	97.2
3	83640	.260	.328	7	7	.211	163	77.0
4	66370	.232	.296	7	7	.267	129	61.2
6	41740	.184	.234	7	7	.423	81	38.5



SPACING OF CONDUCTORS FOR DIFFERENT VOLTAGES.

creases the inductive drop and also the line loss. There are no fixed rules for spacing of lines on transmission poles and towers, however, the accompanying curve shows average practice, in this regard.

The amount of copper called for by any line also depends upon the voltage, it being the general law that the amount of copper varies inversely as the square of the voltage; that is, if the voltage is doubled, the size of wire may be only one-quarter as great, all other conditions remaining the same. In calculating the size of conductors, it is poor policy to use a larger conductor than is absolutely required. The rule governing this is known as Kelvin's Law, and as usually used is stated as follows: "The most economical area of conductor is that for which the annual cost of the energy wasted is equal to the interest on that portion of the capital outlay which can be considered proportional to the weight of the metal used."

While copper and aluminum are the chief metals used for transmission of power, steel wire or conductors with steel center and copper or aluminum outside is used where great mechanical strength is required as in long transmission line spans or where diameter is essential to prevent corona formation. In the use of any metal for wires and cables, the elastic limit must not be exceeded by the weight of the wire between spans and the probable wind and sleet pressure. This condition is met in some cases by the use of a factor of safety of two based upon the ultimate strength of the metal considered.

The overhead line committee of the National Electric Light Association recommends the consideration of the following loads when designing lines: 1.—No ice and wind pressure of 15 pounds per square foot. 2.—Ice ½ inch thick and a wind pressure of 8 pounds per square foot. 3.—Ice ¾ inch thick and a wind pressure of 11 pounds per square foot. The No. 2 loading gives greater stress than No. 1, and is best for use in most localities where ice formation is not a serious problem.

The cost of conductors for a single circuit of 3-No. 4/0 copper cable costs about $1,500 per mile with copper at 15 cents per pound. The cost of smaller sizes of cables is proportionately less, being about one-half for No. 0, about ¼ for No. 3, and about ⅛ for No. 6. For the same loss in the line, the cost of aluminum conductors is about 10 per cent less than that for copper. The total cost of wood pole lines exclusive of right-of-way and engineering, ranges from $1,500 per mile for a 11,000-volt line, using three No. 6 wires, to about $4,000 for 55,000 volts with three No. 4/0 wires. The cost of light tower lines for 55,000 volts, using

Fig. 1. Poles 44 feet high spaced 300 feet with 72 inch wire spacing for 45,000 volts.

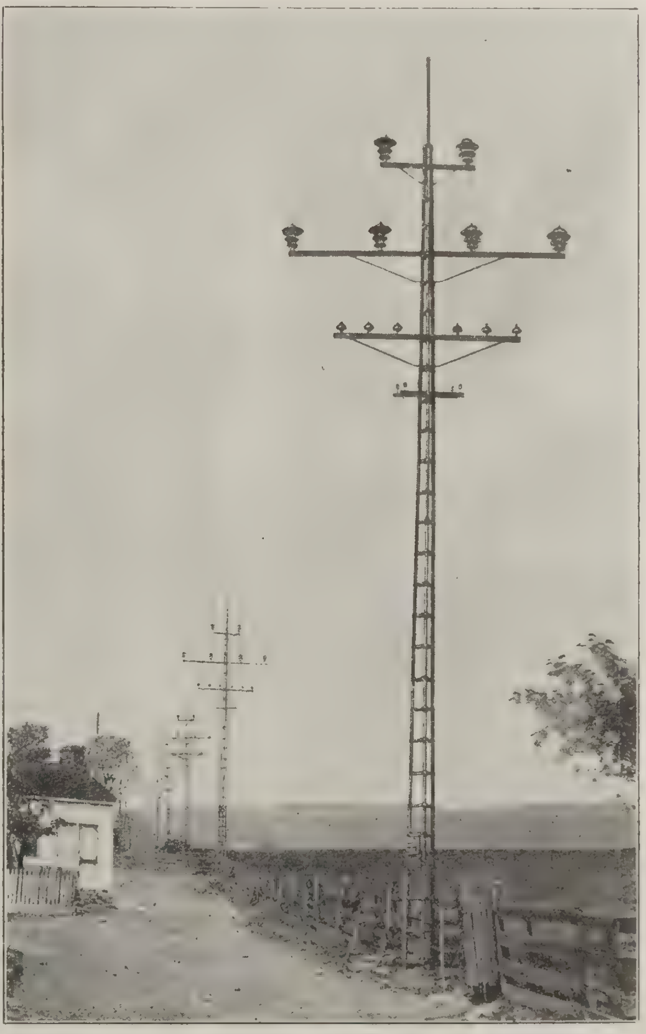


Fig. 2. Poles 51 feet high spaced 200 feet with 52 inch wire spacing for 45,000 volts. Lower double circuit is 6,600 volts. Figs. 1 and 2 are lines of Penn Central Light and Power Co., near Altoona, Pa. Poles manufactured by Franklin Steel Works, Franklin, Pa.

three No. 4/0 wires, will be about the same as for wood poles, namely, \$4,000 per mile. For 110,000 volts, with three 300,000 circular mil cables and steel towers, the cost will be around \$8,000 per mile. To these costs must be added about 25 per cent of the structural cost as charges for engineering, superintendence, tools, equipment, etc. Further data on line costs will be found under heading of Towers and Structures.

Telephone Circuits and Ground Wires.

Telephone circuits are being successfully used on towers of high tension lines with voltages as high as 110,000. In such cases, however, careful engineering and special apparatus is required. Telephone engineering in connection with high tension work is yet in an experimental stage, and little apparatus has been standardized for this work. On wood poles for spans of about 100 feet, a clearance between power conductors at the poles of four feet for 22,000-volt and under, and about 6 feet for 66,000-volt seems to give good talking transmission. For higher voltages, special supports and arrangements are made. Either copper clad wire or hard drawn coper is used for telephone circuits, No. 10 and No. 8 B & S copper being suitable for spans of 125 feet. For long spans on towers, where it is essential to draw the line taut and give good clearance between ground and between power conductors, No. 4 or No. 6 B & S copper-clad wire is often used.

While the absolute value of ground wires has been disputed, it is generally conceded that the protection from lightning they afford on high voltage lines justifies their cost. Ground wires must receive the same consideration as regards clearance as telephone wires. The ground wire when used is usually grounded at each pole or tower and of such a size as to permit drawing taut for the span used. Galvanized steel strand wire about 3/8 inch in diameter is large enough for steel tower use with smaller sizes for short spans.

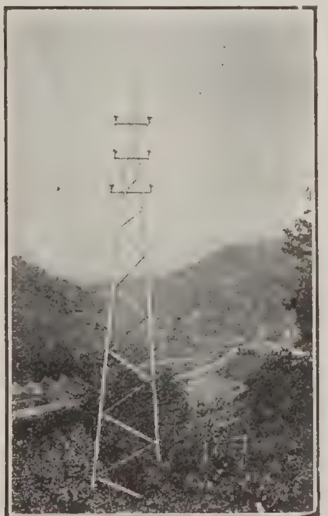
Poles and Towers.

Wood poles are usually the cheapest form of supporting structure for a transmission line, as far as first cost goes, and have been used for lines with voltages up to 66,000. Most modern lines, however, of this voltage use steel poles or towers and the tendency is fast growing to use such structures especially when there is a probability of increasing the voltage on the line in the future. For voltages around 33,000 and above, the wider spacing of

Fig. 4. Transmission line of Salt River Reclamation Project, Mesa-Phoenix, Arizona. Poles 45 feet for 40,000 volts, made by Franklin Steel Works, Franklin, Pa.

steel poles and towers makes the first cost of all steel construction compare favorably with wood poles where the spacing of the latter must be held to 200 feet and considerable anchoring and guying called for. Considerable cost data on wood pole and steel construction is found in the first article of this issue as well as other engineering considerations in regard to these types of construction, so that this matter will not be discussed here.

The minimum clearance between high voltage conductors and the ground is usually considered 20 feet, and between telephone wires on high tension poles and towers and ground, about 18 feet. The usual clearance between conductors should be at least 12 inches per 10,000 volts between wires for voltages of 60,000 and above. The



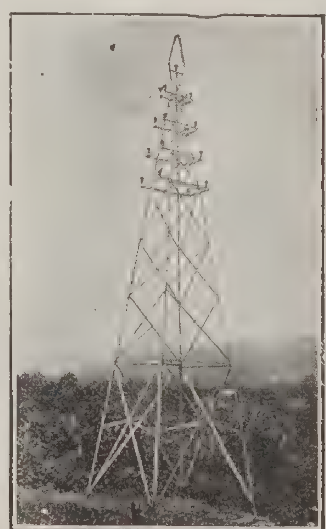


Fig. 3. Designs of Towers manufactured by Riter-Conley Mfg. Co., Pittsburgh, Pa. Flexible towers used with rigid Towers for voltages 22,000 to 60,000.

Fig. 5. Substation Structure Designed by Delta Star Electric Co., Chicago, Ill.

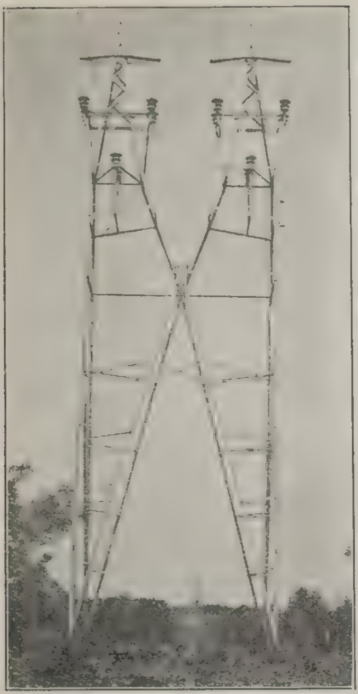
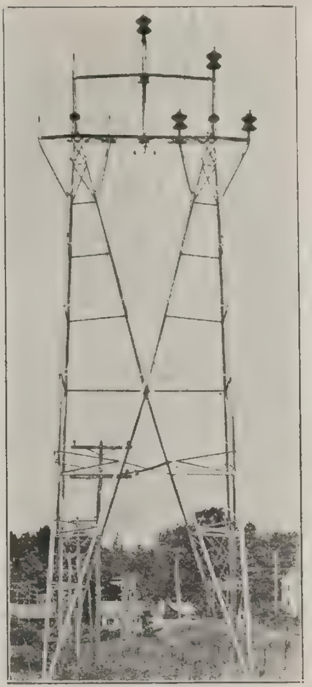
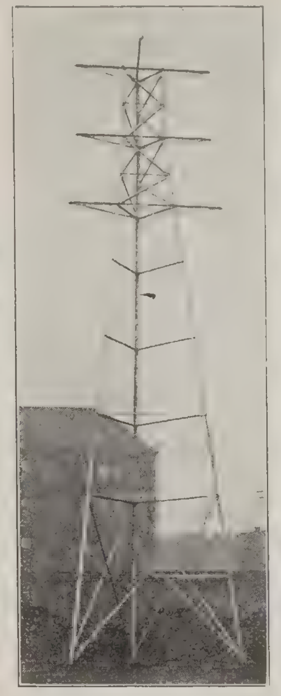
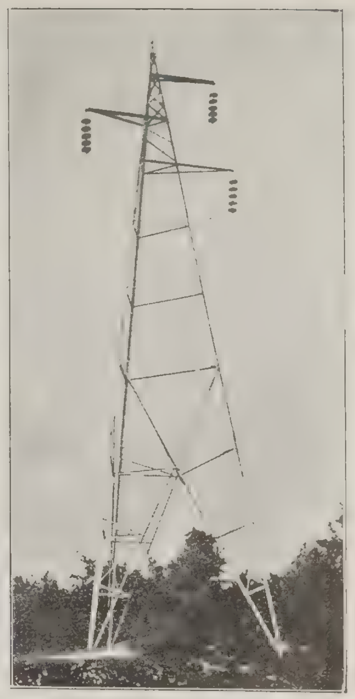





Fig. 6. Towers manufactured by Aeromotor Company, Chicago, Ill. First type was installed by J. E. Sirrine, Greenville, S. C., for Electric Mfg. and Power Co.; Second a 50 foot 66,000 volt tower used by Hudson River Electric Power Co.; Third a three post tower for suspension insulators and 66,000 volts; Fourth, the first tower built for suspension insulators and 100,000 volts, used by Eastern Michigan Power Co.

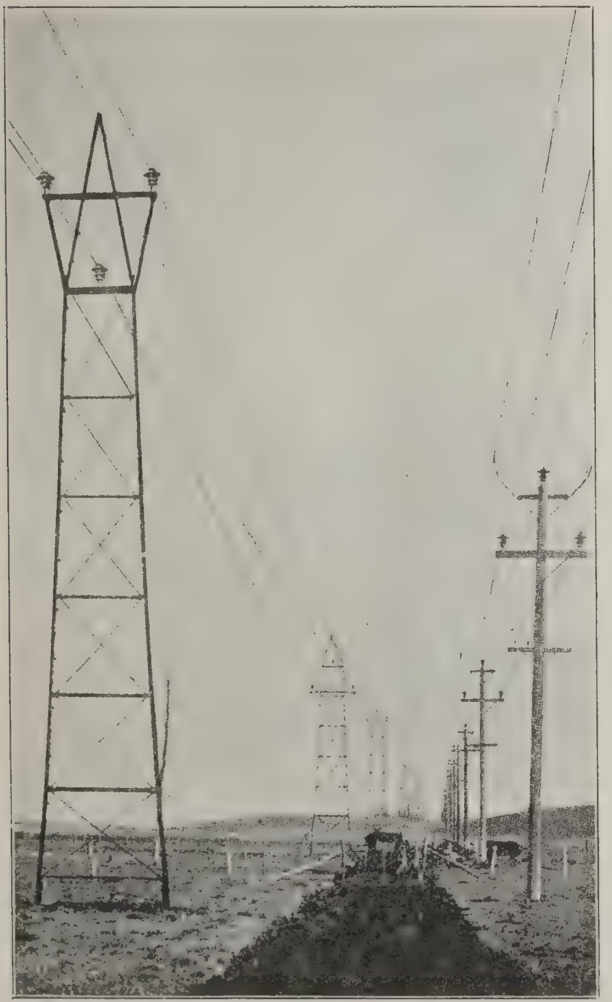


Fig. 7. Flexible Towers 42 feet high to bottom insulator spaced 440 feet for 50,000 volts. Installed by Stone and Webster Eng. Corp., at Taylor Falls, Minn. Towers made by Archbold-Brady Co., Syracuse, N. Y.

Fig. 8. Structure Designed by Transmission Engneering Co., Pittsburgh, Pa.

spacing for lower voltages is given in the accompanying curve. The clearance between line and pole arm of tower must be such that the current will not jump to the tower at a lower voltage than that required to arc over the insulator. This distance is usually made equal to or somewhat greater than the length of the string of suspension insulators used. The spacing dimensions and arrangements of conductors for both wood pole line and steel towers are shown in the accompanying illustrations.

Wood Pole Line Construction.

As an example of a construction for a 33,000 volt wood pole line, installed as single phase with the idea of changing to three phase in the future, we refer to Fig. 10. This line is used for distributing energy to small towns and is 80 miles long. The construction can be changed to 3 phase by installing an additional bracket and give a 36-inch triangular spacing of the conductors. The conductors are of No. 8, 30 per cent copper-clad steel and the insulators known as Thomas No. 2008, Western cedar poles, with 6 and 7 inch tops and 30 feet long are used, spaced 200 feet apart. No overhead ground wire is used, but each pole has a No. 9 iron wire run from top to butt. The line is transposed every half mile and storm guyed every mile.

A wooden arm construction similar to that in Fig. 40 is another design used for a ten mile line of three 33,000 volt, single phase circuits. The pins are known as Pierce clamp type No. 4704, and support Thomas insulators No. 2008, and copper clad steel wires. The wires are arranged in two 36-inch equilateral triangles, and poles are 35 feet, with 8 inch tops of Western cedar, spaced 200 feet apart.

The notable feature of these lines is the extremely low cost of construction. Seventy-five miles of line were erected in thirty-three working days. Most of the holes were dug by a horse-power well boring machine, the average speed being one 18 inch hole, 4½ feet deep, in ten minutes, including moving and spotting the machine. The lines were built along public highways, with special crossings double armed and strung with No. 6 stranded copper clad steel wire. Two men roofed the poles, placed brackets

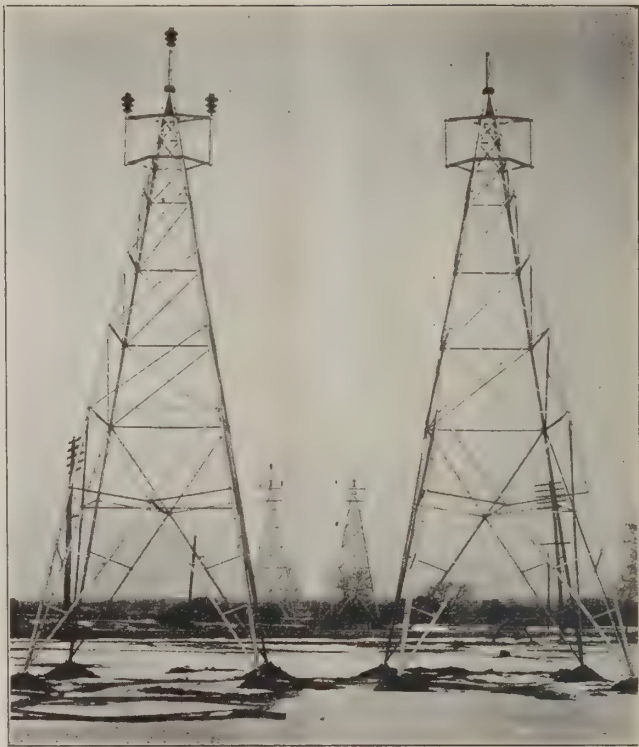


Fig. 12. Towers 50 feet high for Pin Insulators and 66,000 volts. Used by Niagara Lockport and Ontario Power Co., and made by Aermotor Company, Chicago, Ill.

and insulators, stapled ground wires on the poles, and had no trouble in keeping well ahead of the machine. The cost of all labor connected with the surveying and construction of these lines averaged just $75.00 per mile.

Grounding vs Insulating Metal Cross Arms.

In some quarters an objection is raised to operating wood poles with metal cross arms dead grounded, due to the overhead ground wire being clamped directly to the bayonet. In this case the bayonets can be equipped with a Pierce spring thread at the upper end, instead of a ground wire clamp, and the overhead ground wire tied to the insu-

Fig. 9. Structure manufactured by Blaw Steel Construction Co., Pittsburgh, Pa., for Penn. Central Lt. and Power Co., of Altoona, Pa.

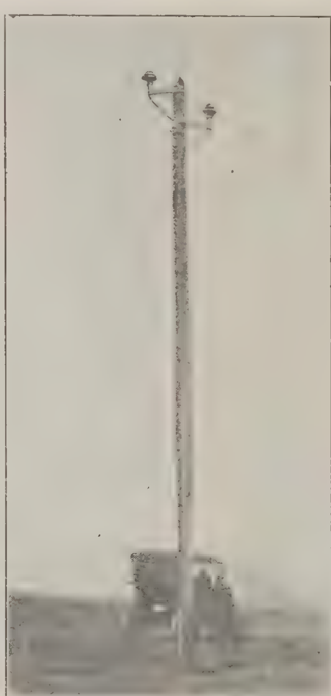
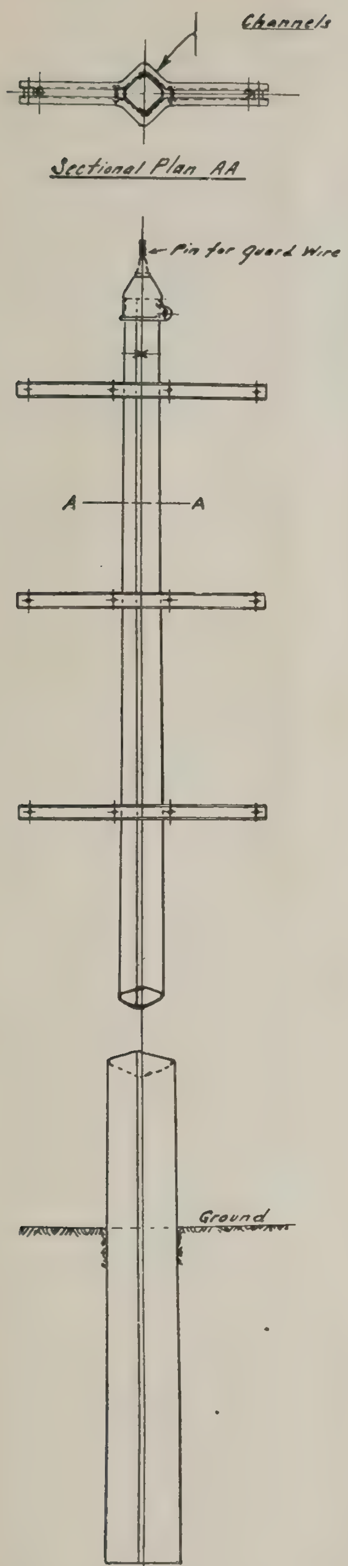


Fig. 10. Wood Pole Line used by W. T. McCaskey and Co., Lansing, Mich., using Hubbard and Company Brackets.

Fig. 11. Wood Pole Line built by Interstate Power Co., Armour, S. D., using Hubbard and Company Brackets.



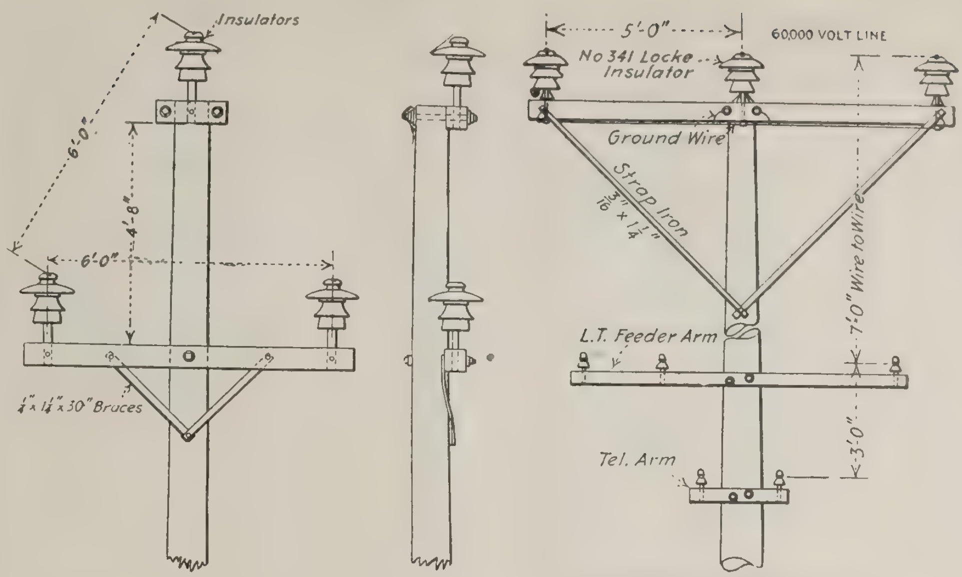


Fig. 15. Designs for Wood Pole Tops without Ground Wire for 60,000 volts.

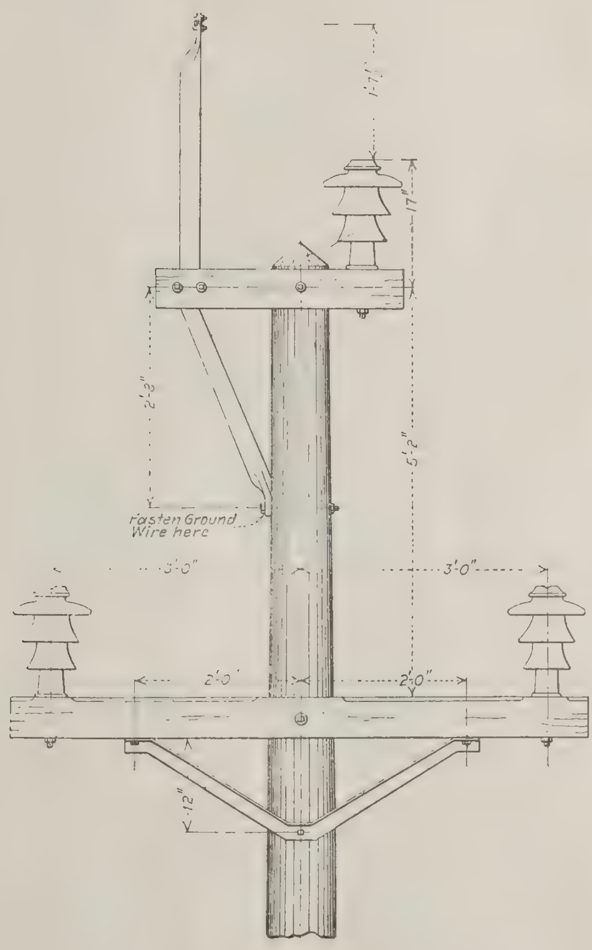


Fig. 13. Design of Steel Pole made by Diamond Steel Pole Co., Philadelphia, Pa.

Fig. 14. Design of Steel Pole made by Hubbard & Co., Pittsburgh, Pa.

Fig. 16. Design of Wood Pole Top With Ground Wire for 50,000 volts.

lator, thus effectually insulating it from the arm. This plan was developed by Mr. H. N. Muller, superintendent of distribution of the Duquesne Light Company, of Pittsburgh, and has been adopted by many eastern companies. This arrangement, it will be seen, retains the full protective value of the overhead wire, with the operating advantage of an undergrounded arm, and is a very sound construction mechanically.

The advisability of insulating as opposed to grounding the arms depends on whether it is desirable to nurse weak insulators and maintain services with grounds on the line, or not. With insulated arms the insulating value of the pole to ground is retained, and in case of an insulator failure, only the two remaining insulators on the arm in question will be subjected to full line voltage, whereas with grounded arms two-thirds of the insulators on the line will

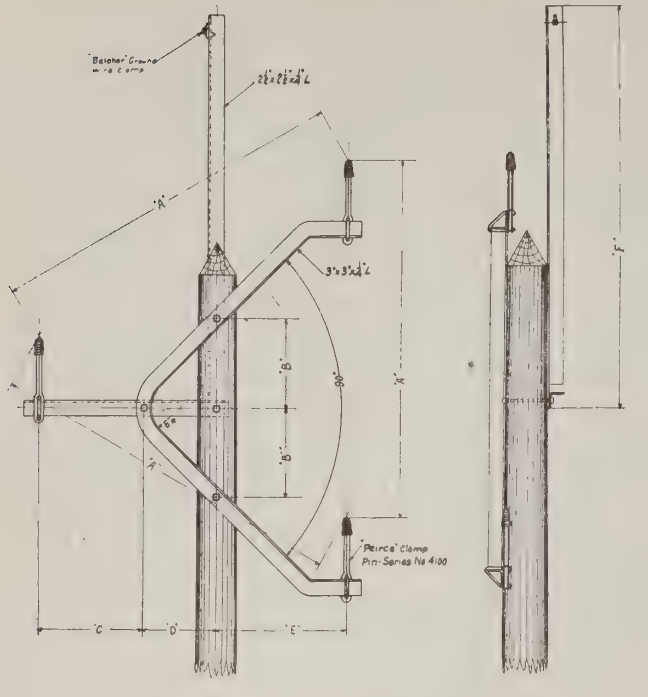
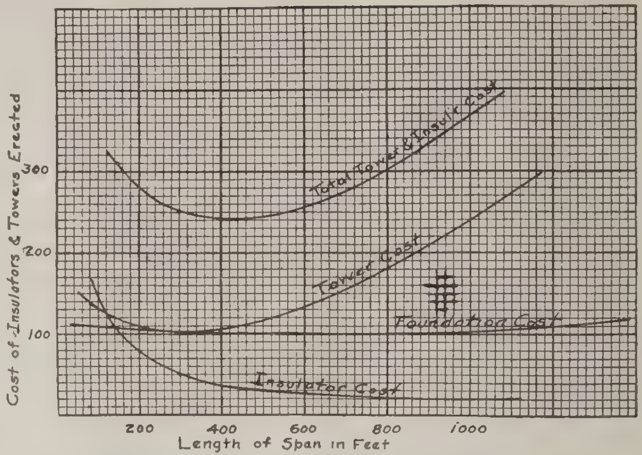


FIG. 17. A DESIGN ON CROSS ARMS FOR 33,000 VOLTS, WITH A = 36 IN.; B = 12 5/16 IN.; C = 6 IN.; D = 12 IN.; E = 13.5 IN.; F = 50 IN.

have the full line voltage impressed across them, which is sure to locate any "weak sisters," with a resultant short circuit and interruption of service until repairs are made. The problem is similar to that of grounding the neutral of a star connected system, and in general, it is well to insulate the arms on lines serving important loads with no other source of supply, and to ground the arms in net works or where emergency service is provided. For ungrounded systems better results will be obtained with ungrounded



COST DATA ON TOWER INSTALLATION.

arms. Where the system neutral is grounded the metal cross arm should be earthed.

Transmission Line Costs.

Cost figures for transmission lines can be given only in an approximate way, since the size and cost of the conductor and the nature of the country passed through greatly effect line costs. However, in addition to the approximate estimates given under the heading of conductors, we may call attention to the following items which go to make up transmission line costs. These items are cost of right-of-way, cost of conductors, and cost of towers. The relation of the two last items are approximately shown in the accompanying curve. These curves show relative costs of mechanical equipment rather than give any precise data and must not be taken except as an approximate average for lines in general. The cost of right-of-way varies according to the value of the land in the territory crossed, and in all cases is more than the value considered for

SIZE OF LINE		APPROXIMATE NET COST PER MILE OF MATERIAL AND LABOR						
Conductors	Size of Poles	Poles and Cross Arms	Insulators and Pins	Ground Wire and Bayonets	Copper Wire	Telephone Line No. 10 Copper Clad	Labor and Supervision	TOTAL COST PER MILE OF LINE
No. 0	35′ 7″	42—35′ 7″ @ $8.70 ea. 4—40′ 7″ @ 11.00 ea. 2—45′ 7″ @ 13.30 ea. 48—Arms @ 1.33 ea. Total Cost=$499.84	150 Insulators @ $.45 ea. 48 (set of 3) clamp pins @ $.55 ea. Total Cost=$93.90	5800 ft. 3/8″ ground and guy wires @ $11.50 per M 48 Bayonets @ .57 ea. Total Cost=$94.06	5400 lbs. @ $.16 lb. 75 lbs. No. 4 tie @ $.16 lb. Total Cost=$876.00	320 lbs. @ $.15½ lb. 48 brackets .10½ ea. 96 insulators @ $.04½ ea. 96 lags.(½″x6″)@ .03½ea Total Cost=$62.32	Labor, teaming Supervision $450.00	Poles and arms.. .. $499.84 Insulators and pins. 93.90 Ground wire & bayonets. 94.06 Conductors and ties. .. 876.00 Telephone Line. 62.32 Labor and Superv 450.00 Total Cost... ... $2076.12
No. 2	35′ 7″	42—35′ 7″ @ $8.70 ea. 4—40′ 7″ @ 11.00 ea. 2—45′ 7″ @ 13.30 ea. 48—Arms @ 1.33 ea. Total Cost=$499.84	150 Insulators @ $.45 ea. 48 (set of 3) clamp pins @ $.55 ea. Total Cost=$93.90	5800 ft. 3/8″ ground and guy wires @ $11.50 per M 48 Bayonets @ .57 ea. Total Cost=$94.06	3500 lbs. @ $.16 lb. 75 lbs. No. 4 tie @ $.16 lb. Total Cost=$572.00	320 lbs. @ $.15½ lb. 48 brackets .10½ ea. 96 insulators @ $.04½ ea. 96 lags (½″x6″ @ .03½ ea. Total Cost=$62.32	Labor, teaming Supervision $425.00	Poles and arms... .$499.84 Insulators and pins. . 93.90 Ground wire & bayonets. 94.06 Conductors and ties. . 572.00 Telephone Line...... 62.32 Labor and Superv.. .. 425.00 $1747.12
No. 0	30′ 7″	36—30′ 7″ @ $5.50 ea. 6—35′ 7″ @ 8.70 ea. 4—40′ 7″ @ 11.00 ea. 2—45′ 7″ @ 13.30 ea. 48—Arms @ 1.33 ea. Total Cost=$384.64	150 Insulators @ $.45 ea. 48 (set of 3) clamp pins @ $.55 ea. Total Cost=$93.90	5800 ft. 3/8″ ground and guy wires @ $11.50 per M 48 Bayonets @ .57 ea. Total Cost=$94.06	5400 lbs. @ $.16 lb. 75 lbs. No. 4 tie @ $.16 lb. Total Cost=$876.00	320 lbs. @ $.15½ lb. 48 brackets .10½ ea. 96 insulators @ $.04½ ea. 96 lags (½″x6″ @ .03½ ea. Total Cost=$62.32	Labor, teaming Supervision $425.00	Poles and arms ... $384.64 Insulators and pins. . . 93.90 Ground wire & bayonets. 94.06 Conductors and ties.... 876.00 Telephone Line.. .. 62.32 Labor and Superv . 425.00 $1935.92
No. 2	30′ 7″	36—30′ 7″ @ $5.50 ea. 6—35′ 7″ @ 8.70 ea. 4—40′ 7″ @ 11.00 ea. 2—45′ 7″ @ 13.30 ea. 48—Arms @ 1.33 ea. Total Cost=$384.64	150 Insulators @ $.45 ea. 48 (set of 3) clamp pins @ $.55 ea. Total Cost=$93.90	5800 ft. 3/8″ ground and guy wires @ $11.50 per M 48 Bayonets @ .57 ea. Total Cost=$94.06	3500 lbs. @ $.16 lb. 75 lbs. No. 4 tie @ $.16 lb. Total Cost=$572.00	320 lbs. @ $.15½ lb. 48 brackets .10½ ea. 96 insulators @ $.04½ ea. 96 lags(½″x6″)@.03½ ea. Total Cost=$62.32	Labor, teaming Supervision $400.00	Poles and arms..... . $384.64 Insulators and pins.. . 93.90 Ground wire & bayonets. 94.06 Conductors and ties.. . 572.00 Telephone Line... . 62.32 Labor and Superv. 400.00 $1606.92

TRANSMISSION LINE COSTS FOR 3-PHASE, 33,000 VOLTS USING TYPE OF POLE AND CROSS ARMS SHOWN IN FIG. 17.

farming purposes. This cost may be taken, however, as about $200 per acre, so that a right-of-way 100 feet wide calling for twelve acres to the mile, the right-of-way cost is about $2,400 per mile. This is an additional cost not shown in the curves.

As observed from the curves, the controlling factors of line costs over and above right-of-way are tower costs and insulator costs. As the size and price of insulator is increased, the economical length of span would be increased so it follows that the higher the voltage, the longer the span. For an average voltage line, the economical span is somewhere between 300 and 500 feet, with the structure in each case light. Foundation costs are practically constant, due to the fact that the strength of the foundation against a force tending to pull it out of the ground is proportional to the weight of the foundation. Thus the cost of the foundation is proportional to this force, resulting in a practically constant value for the cost of foundation per 1000 feet of line.

Transmission Line Insulators.

Power companies are beginning to realize that the insulator is perhaps the most important item of a modern transmission line, for upon the insulator depends the reliability of the company's service to its customer. For transmission purposes at this time, porcelain insulators can be classified as one piece, multi-part pin types and suspension types. The one piece insulator is used generally

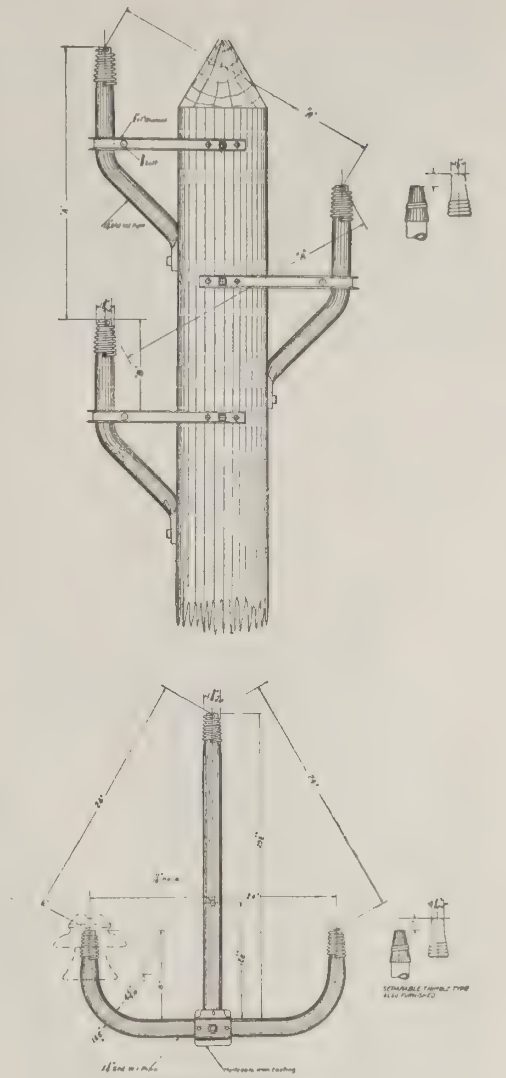
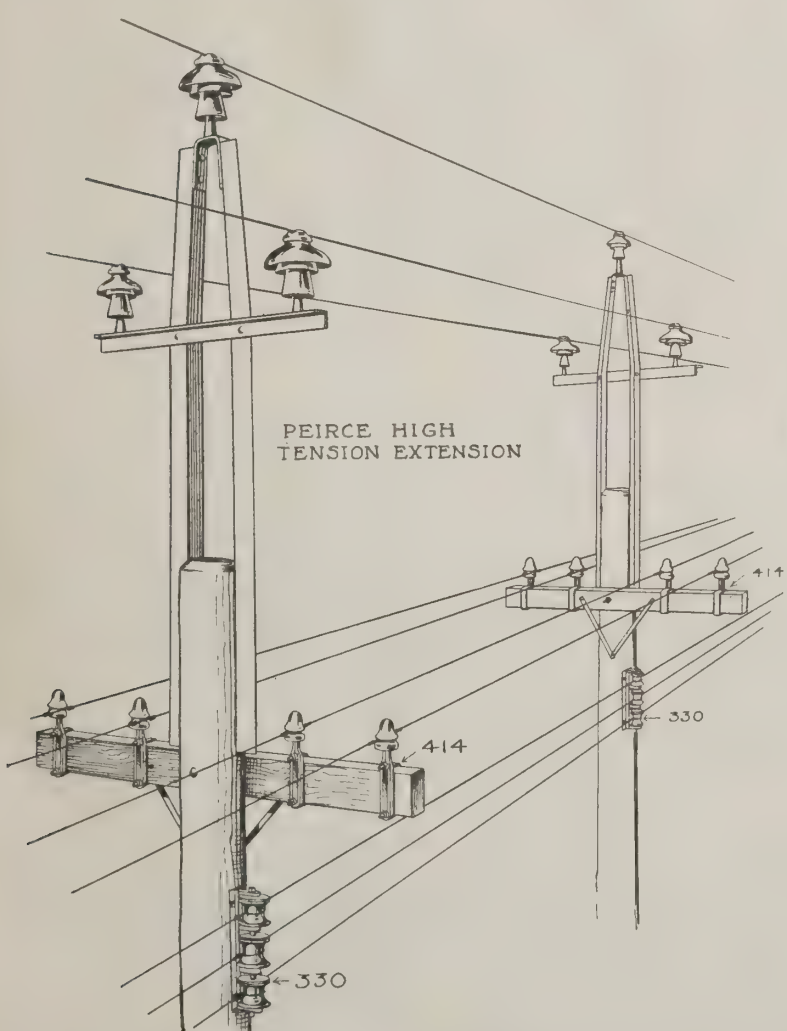


Fig. 19. Wood Pole Brackets and Arrangements made by Hubbardand Co., Pttsburgh, Pa.



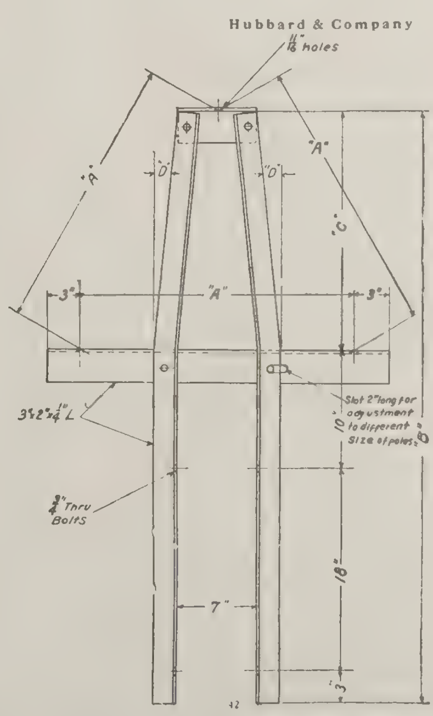


Fig. 18. Arrangement for Making High Tension Extension to Exist ing Pole Line. Design by Hubbard and Company, Pittsburgh, Pa.

for voltages up to 20,000 volts. The multi-part insulator can be used to 80,000 volts, while beyond this voltage the suspension types have taken the place of multi-part pin types.

In the beginning, the modern high-tension insulator was a petticoat insulator of the same cylindrical form as low voltage telephone and telegraph insulators used, but slightly larger in dimension. Surface insulation was considered the vital point and the designs were made accordingly. Later developments brought about the incline of the petticoat outward, getting same further away from the bolt and keeping the inner surface dry. The weight and complications of manufacture in this regard thus brought about the multi-part insulators cemented together.

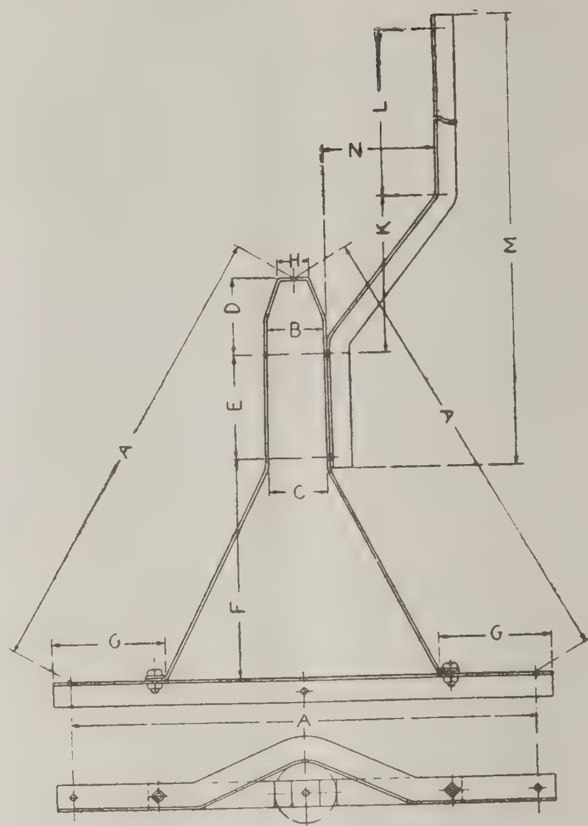


FIG. 20. WOOD POLE TOP ARRANGEMENT MADE BY ELECTRIC SERVICE SUPPLIES CO., PHILADELPHIA, PA.

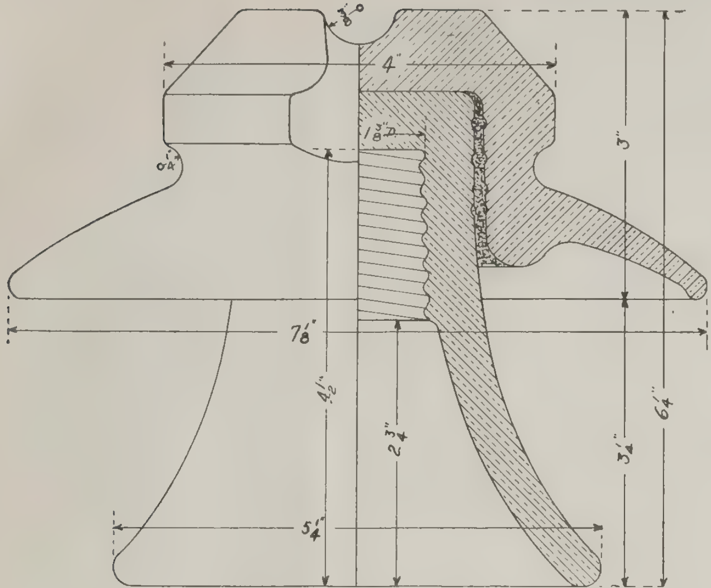
In the selection of an insulator of the pin type to operate under certain pressures, consideration must be given to the mechanical features involved, and also the internal electrical conditions of the system; the climatic conditions, such as long rainy seasons, salt storms, fogs, dust, lightning storms, etc. Experience has taught the transmission line engineer some undesirable features of an insulator, yet it has required long and careful work on the part of manufacturers to develop economical and efficient designs, and it is usually best to specify performance, and have the manufacturer furnish insulators to meet conditions of service to be rendered. The specifications for multi-part insulators usually itemize the tests for performance and in some cases specify in detail the manner in which they are to be applied. For dry flash-over as a rule 2½ to 3 time the rated line voltage is specified. And for the wet flash-over 1½ to 2 times the rated line voltage. A puncture test of usually 75% of the full rated line voltage, applied to the different shells separately before assembling. Very often, too much attention is given the wet flash-over test values that are obtained on insulators, and too little attention paid to dielectric strength and surface resistance to meet line conditions.

A great number of different designs of suspension type insulators are offered by manufacturers, but in general two types have been widely used. The interlinking type and the one piece disc type with a metal cap and center pin cemented to insulators. The first design has the advantage that in case the insulator breaks the wires will hold the other units together, and in good many cases prevent a shut down, but against this there is the possibility of their breaking from constant rubbing in the holes. In the one type the insulator is in tension, while the interlinking type is in compression. In general the principles of design of pin insulators are applicable to the suspension insulator as the latter may be considered as a modification of the former. In the early designs of suspension units, a disc type without petticoats was employed, but the latter designs make use of concentric circular ribs or petticoats on the under surface, the addition of the petticoat raises the sparking voltage 35% and at the same time increases the surface resistance in wet weather.

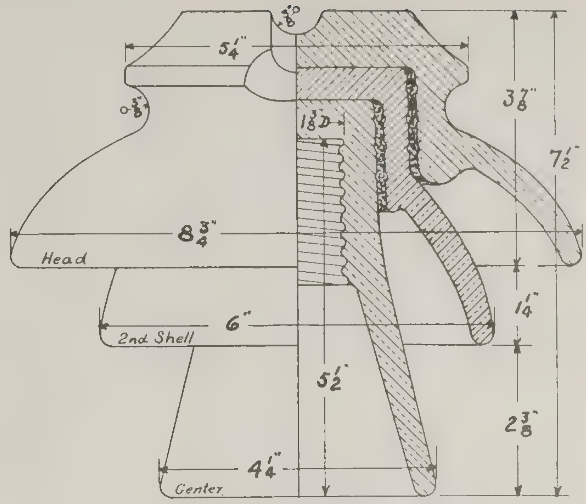
Suspension insulators have a smaller capacity than the multi-part insulator, this capacity diminishing as each unit is added, but increasing for the large sizes of multi-part for higher line pressures. However, a wide multi-part insulator gives better rain protections than the narrower but larger suspension group, yet the number of dry surfaces of the latter gives a smaller surface leakage loss.

The following information on glass insulators for high tension work is abstracted from a paper read at a meeting of the American Institute of Electrical Engineers:

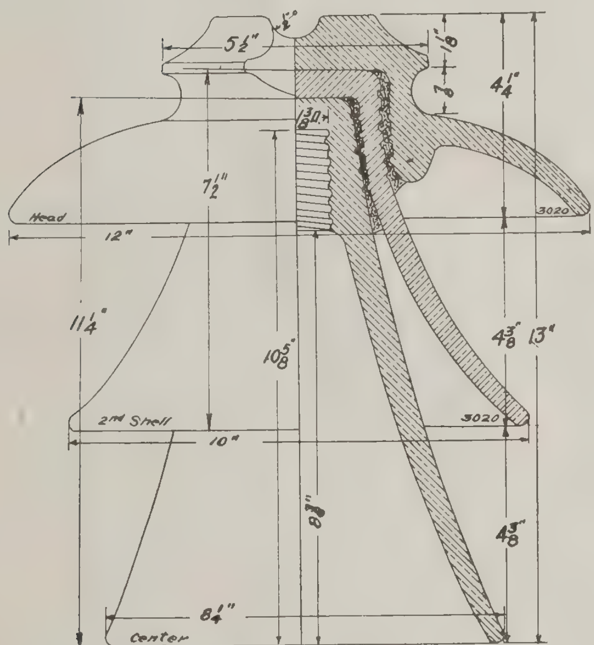
"Glass was the first material to be used for insulators on trasmission lines in the United States, and it has shared with porcelain, this application. In France glass is extensively used for transmission lines, we understand, up to 100,000 volts, while in Italy many power lines are similarly equipped. There are 5,000,000 glass insulators giving good satisfaction over high tension lines today in the United States. The question is one both of material and of construction. Fundamentally, glass is superior because, being of homogeneous character and a single material, the entire body of the glass acts uniformly as the insulating medium, whereas in porcelain the glaze appears to be the main factor of insulation resistance and differs in composition from the body of the substance which is



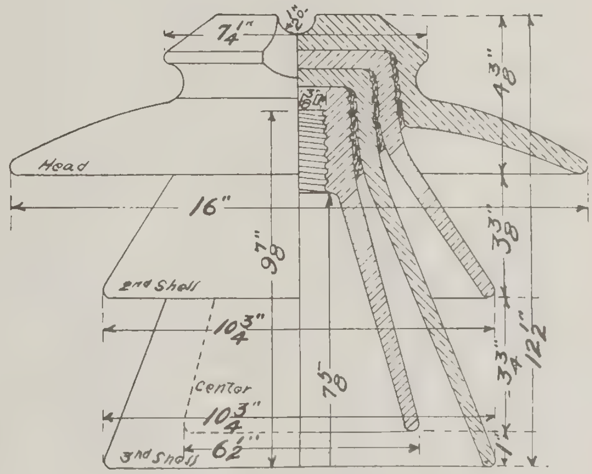
No. 2041 for 22,000 volts.



No. 3008 for 33,000 volts.



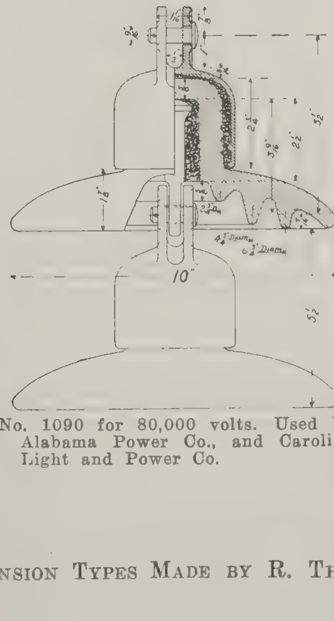
No. 3024 for 44,000 volts.



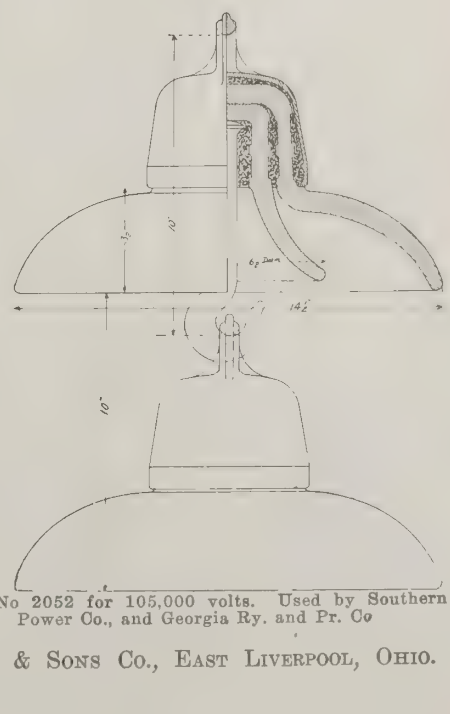
No. 4004 for 66,000 volts.

No. 1009 for 6,600 volts.

No. 2008 for 11,000 volts.



No. 1090 for 80,000 volts. Used by Alabama Power Co., and Carolina Light and Power Co.

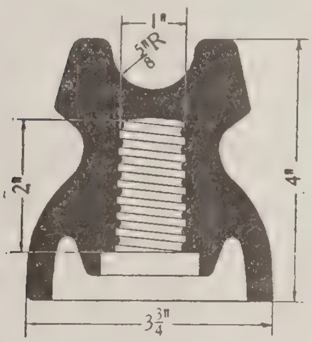


No 2052 for 105,000 volts. Used by Southern Power Co., and Georgia Ry. and Pr. Co

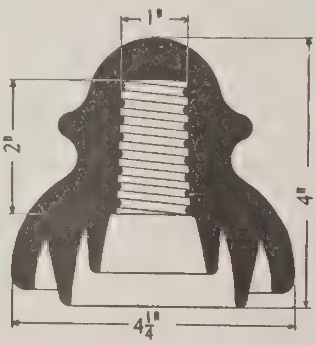
FIG. 21. INSULATION OF PIN AND SUSPENSION TYPES MADE BY R. THOMAS & SONS CO., EAST LIVERPOOL, OHIO.

far inferior to glass in this respect. Now, when it is recalled that this glaze may be but a thousandth of an inch or so in thickness, it is obvious that any imperfections or uneveness in its texture are sure to be fraught with danger. This is further emphasized by recent improvements in glass manufacture which result today in a material, uniform in character, of greater strength and specific gravity, where increased mechanical efficiency and strength are combined with the desired insulating properties. This improvement has followed technical developments in glass making just as in steel and other industries, and is due primarily to a better understanding of the chemical and physical questions involved."

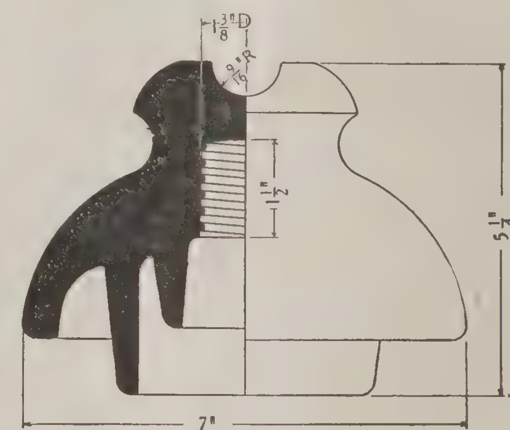
Unfortunately, glass manufacturers in the United States have failed to realize adequately, the availability of their product for high tension work. In the first place, for the new and unusual shapes required, they at first demanded prices that if not prohibitive, plainly suggested an unfair profit. Secondly, the manufacturers failed to consider sufficiently, the electrical side of the problem and did not show a progressive spirit in arranging testing plants and methods of test and experiment. Furthermore, such concerns as have developed improved methods of manufacture, have failed to publish the results of their improvements so that to many engineers, the merits and relative economy of glass as compared with other materials, has never been made apparent. For these reasons chiefly, porcelain has achieved a position in this field which modern glass insulators are now in a position to dispute. Just as the problem of a high tension innsulator was solved in porcelain by the suspension insulator, so similar designs have been developed for glass which are now gaining wide vogue. It will be remembered that a porcelain pin insulator required for a 100,000-volt transmission line could be built only of such size and form as to cost the prohibitive amount of about $30.00, but that this combining of a number of insulators by cementing to malleable iron fittings and suspending the cable, high tension insulators of such capacity could be secured at a cost of about five or six dollars. Likewise for glass, the suspension insulater is being developed for high tension lines and types now in use meet all conditions in a most satisfactory manner and often more advantageously than porcelain. Instead of making the glass about three inches thick as has to be done with a pin type insulator where stresses are almost unavoidable, the same result can be secured with glass ¾ of an inch thick. This permits of perfect annealing and the development of a glass with practically the same strength as porcelain. In such disks corrugations of the necessary shape can be molded so that the cement holding the various segments together will have a firm hold and afford an insulator of equal strength to a solid piece.



No. 2 for 6,600 volts.

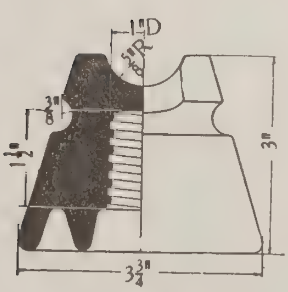


No. 135 for 10,000 volts.

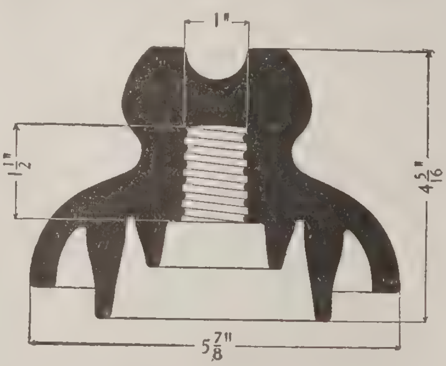


No. 137 for 20,000 volts.

Fig. 22. Designs of Glass Insulators made by Brookfield Class Co., New York City.

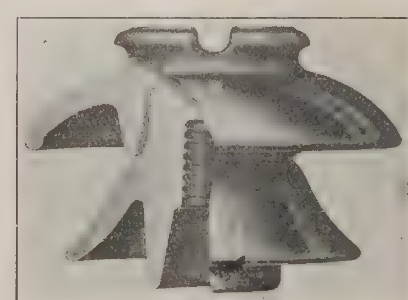


No. 118 for 6,600 volts.



No. 136 for 15,000 volts.

Fig. 23. Designs of Glass Insulators made by Brookfield Glass Co.



Ohio Brass Insulator for 35,000 volts.

Fig. 24. Designs of Insulators made by Pittsburgh High Voltage Co., Pittsburgh, Pa.

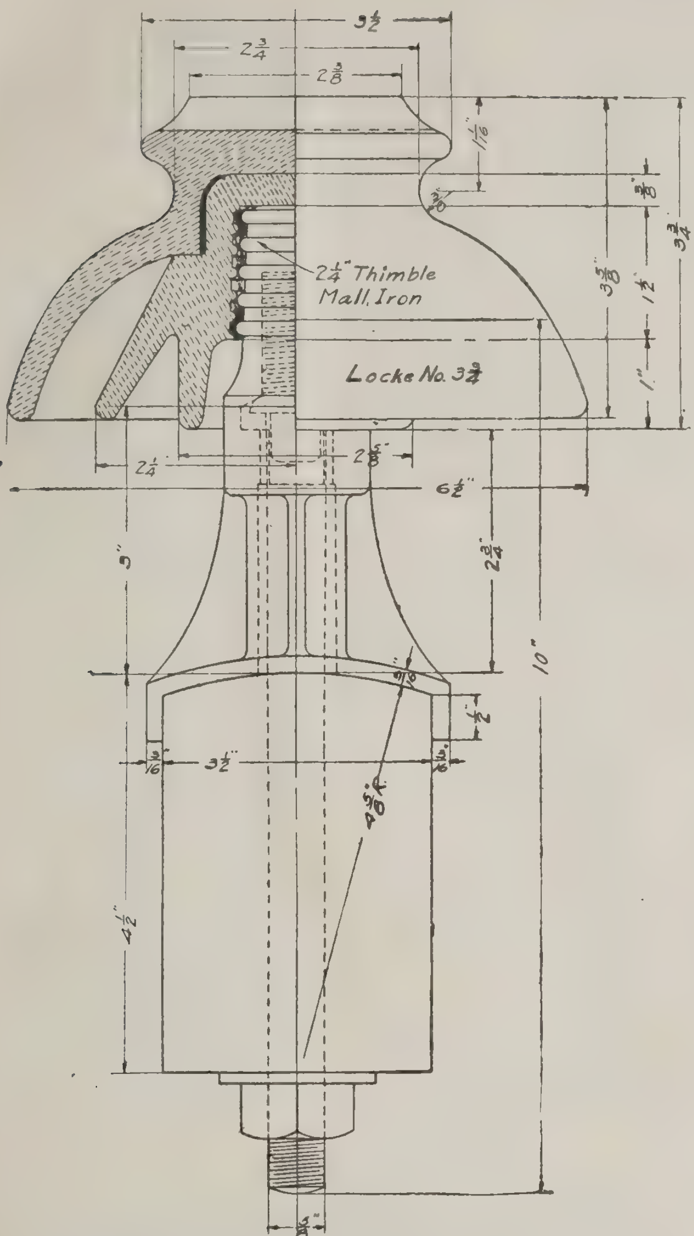


Fig. 25. Design of Pin for Wood Cross arm and High Tension Insulator. Made by Electric Service Supplies Co., Philadelphia, Pa.

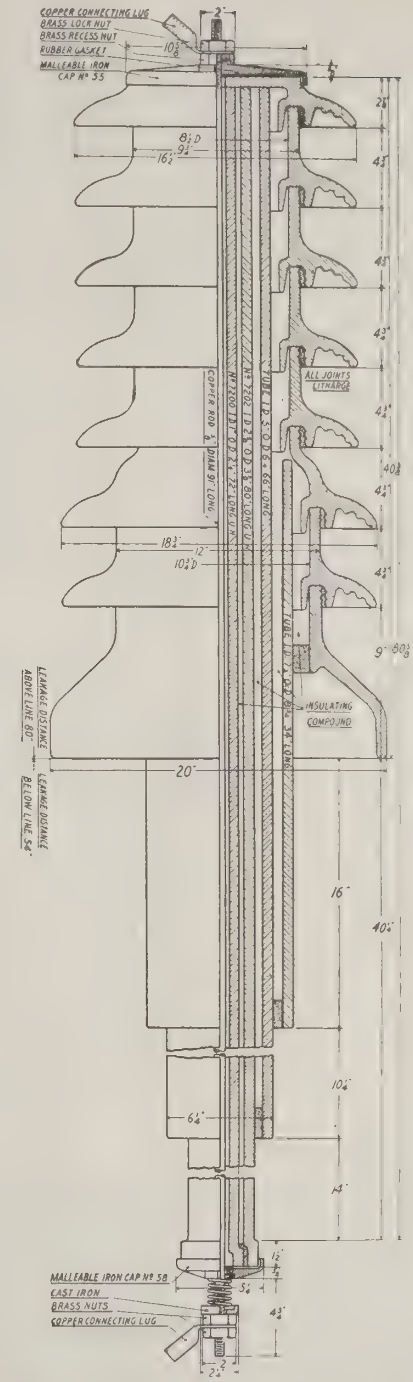


Fig. 26. Design of Roof Insulator for 80,000 volts by R. Thomas and Sons Co., East Liverpool, Ohio.

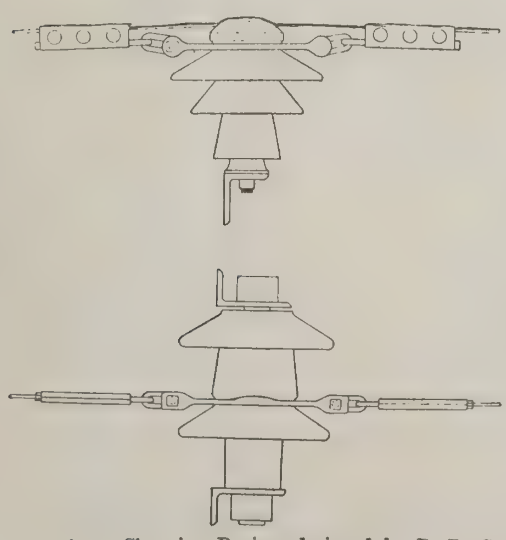
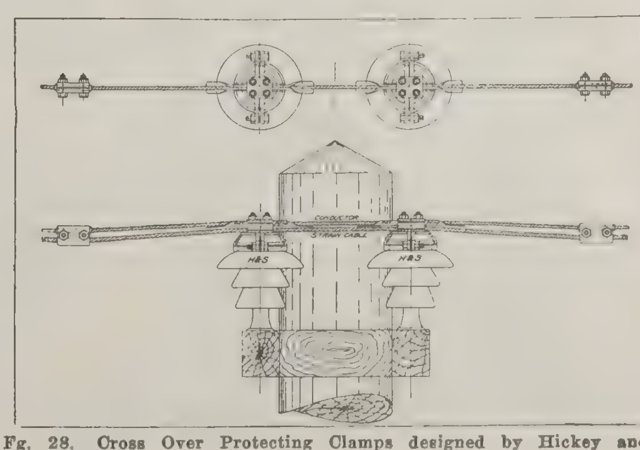


Fig. 27. Insulator Clamping Devices designed by R. D. Combs and Co., New York City.



Fg. 28. Cross Over Protecting Clamps designed by Hickey and Schneider, Elizabethport, N. J.

Today these composite insulators of glass have been developed to a point where samples of suspension insulators are supplied by glass manufacturers for comparative tests with those of porcelain, irrespective of the voltage for which the line is to be used. For long distance telephone communications, comparative tests have been made of glass insulators and those of other materials along parallel lines, and the practical results as shown in more distinct conversation, have coincided with the reports from the testing laboratory, while the power lines on the Pacific Coast where glass has been used all return satisfactory reports. One objection to glass insulators has been that they could only be used with wooden pins. The more perfectly annealed glass insulators have been used with iron pins dipped in pitch and stand up as well as the porcelain. Another objection has been that internal stresses are caused in the piece due to poor annealing. This has been eliminated by a flashover test of say five minutes and by the more perfect methods of annealing.

An important reason for using suspension insulators is the matter of cost. It is entirely possible to build porcelain insulators of the pin type in standard design of sufficient size to operate successfully at any voltage, but the extreme height and diameter of a pin type insulator for, say, 100,000 volts makes the cost prohibitive. Suspension insulators are usually made up on the unit plan, making it possible to increase the effective insulation whenever it is desired to raise the line voltage or whenever it is found necessary to increase the leakage surface of the insulators in districts where salt fogs or dust deposits from factories are encountered. Many lines start operation at a lower voltage than will be eventually used because the initial load is light and the potential increased when the regulation demands it. If the pin type of insulator is considered at the start in such a case, there is no choice but to install the size of insulator that will be ultimately required. Again in the pin type of design, the nearness of the line wire and pin must always prove a weak point for lightning as well as any surging or other line disturbances. The suspension type of insulator gets around both these troubles by the wide separation of the conductors and supporting structure. Again when the suspension type is used on towers, the position of the conductor below the cross-arm permits the tower to act as a lightning rod, and said to relieve the line from much lightning stress.

Insulators are a source of much line trouble and in the matter of breakage the unit suspension type has a positive advantage. When a pin type insulator becomes cracked the whole insulator is worthless so far as its electrical properties go, and must be removed at once or it may cause a shut-down during the first rain storm. The breaking or cracking of one of the units of a suspension unit type insulator takes away but one unit of the series. Thus, in a five-unit design for 100,000 volts, the breaking of one unit reduces the insulating value only 20 per cent. The suspension insulator requires a higher tower and pole for the same wire clearance than when using the pin type design, for the conductor is below the cross-arm and a longer cross-arm is also required to allow for the swing of insulators and wires in the wind.

On account of these features, a construction dealing with voltages above 50,000 is now considered about the dividing line between pin type and suspension type insulators, with a suspension type often used on lower voltages where there is the possibility of increasing the voltage of the line in the future, as already mentioned.

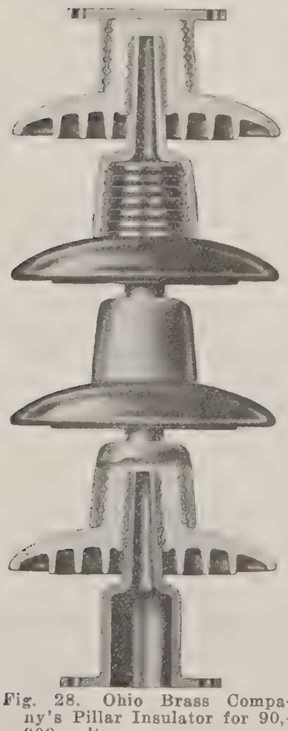


Fig. 28. Ohio Brass Company's Pillar Insulator for 90,000 volts.

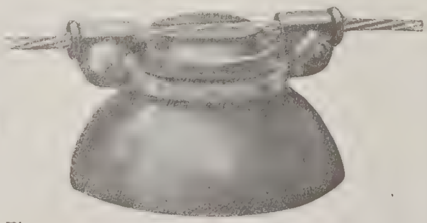


Fig. 30. Design of Clamp Used by Southern Power Co., and made by Hickey and Schneider, Elezabethport, N J.

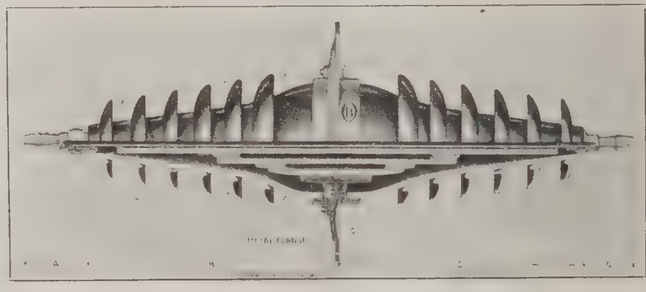
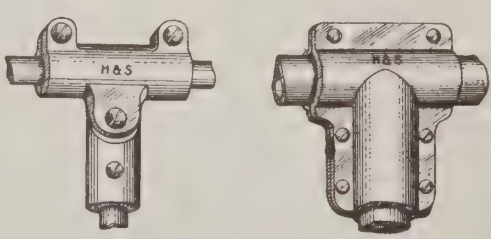


Fig. 32. Design of Wall Insulator for 150,000 volts, by Ohio Brass Co, Mansfield, Ohio.



Type A Type B

Fig. 31. Line Taps made by Hickey and Schneider, Elizabethport, N. J.

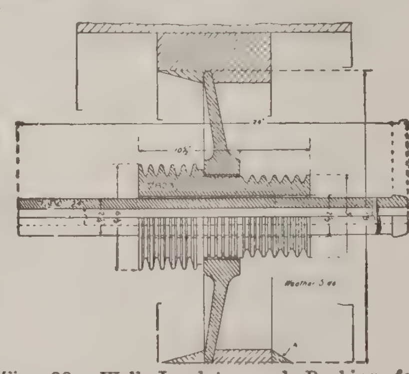


Fig. 33. Wall Insulator and Bushing for 33,000 volts. Designed by R. Thomas and Sons, East Liverpool, Ohio.

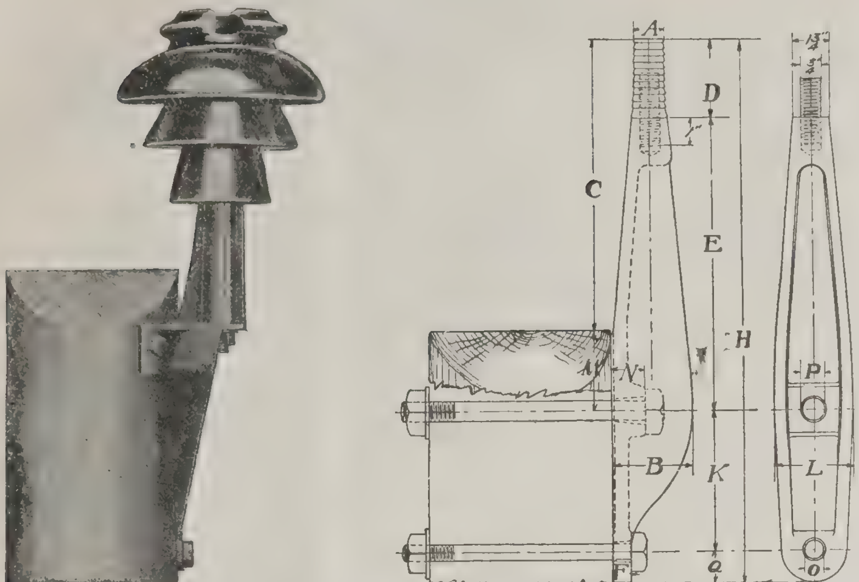


Fig. 34. Pole top Pins Designed by Electric Service Supplies Co., Philadelphia, Pa., and Fletcher Mfg. Co., Dayton, Ohio.

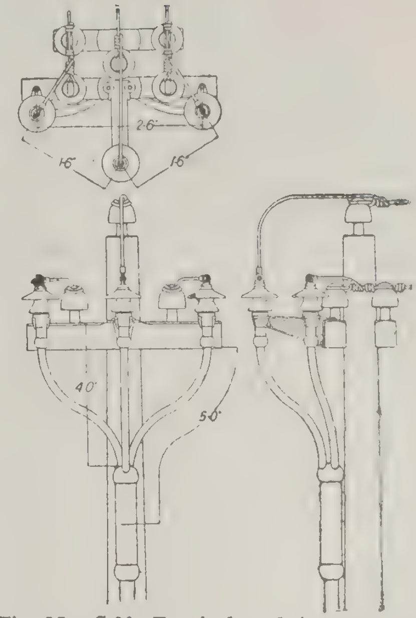


Fig. 35. Cable Terminals and Arrangements made by Standard Underground Cable Co., Philadelphia, Pa.

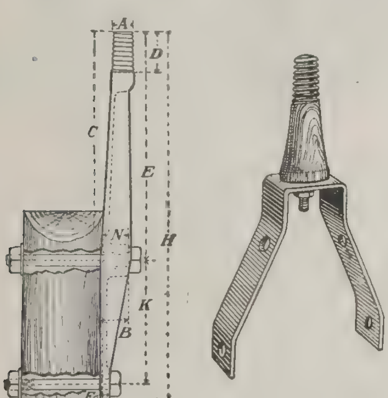


Fig. 26. Pole Top Pin and Ridge Iron made by Fletcher Mfg. Co., Dayton, Ohio.

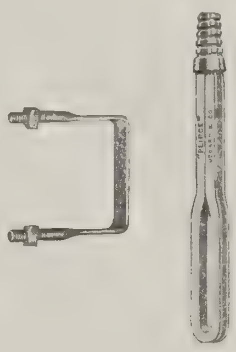


Fig. 37. Metal Pin and Clamp made by Hubbard and Co., Pittsburgh, Pa.

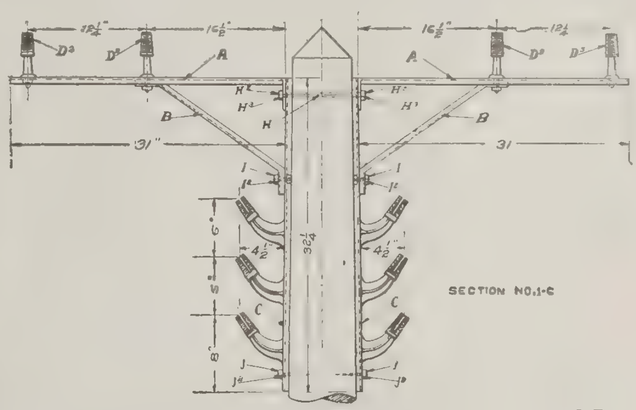


Fig. 38. Pole Top Bracket made by W. N. Mathews and Bro., St. Louis, Mo.

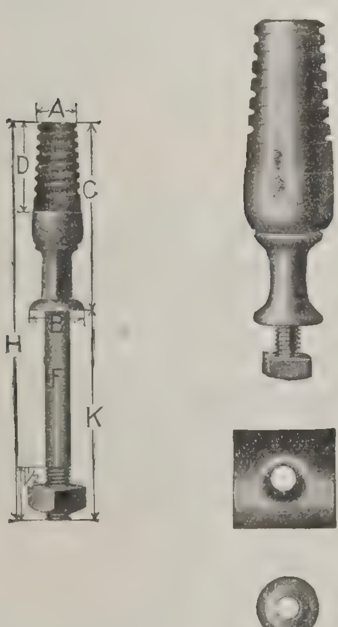
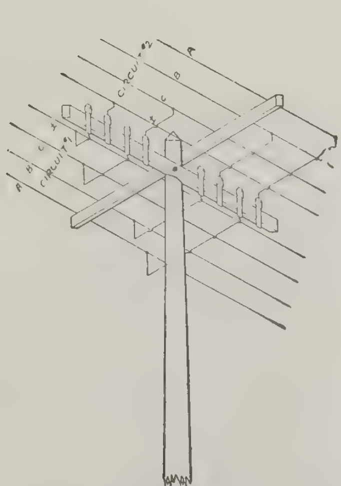


Fig. 39. Pins for Wood and Metal Arms made by Barnes and Kobert Mfg. Co., New Haven, Conn.



Potheads for switching, made by G & W Electric Specialty Co., Chicago, Ill.

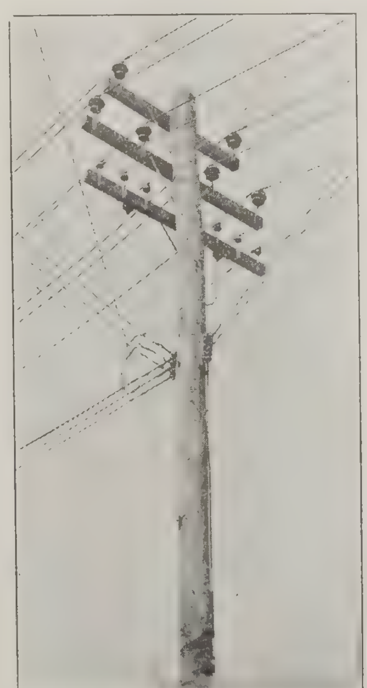


Fig. 40. Clamp types of pins made by Hubbard and Co., Pittsburgh, Pa.

Cross Arms and Pins.

For wood pole contruction, the durability of cypress as the material for cross arms and pins has been pretty well established, it being claimed that pins and cross arms made of heart cypress, such as the Louisiana red cypress grades, will last twenty years under exposed conditions. Cypress may be used in its natural state without painting or treatment, but gives greater life when impregnated with a preserving oil such as "cypressene." Good grades of cypress are grown in the states of Louisiana, Florida, and some parts of Georgia and South Carolina. Other woods, such as Norway pine, longleaf yellow pine, Douglas fir ,oak and spruce are used in some localities where stocks of same are easily available.

Cross arms of both wood and steel are generally used for high tension lines of voltages between 2200 and 33,000. The wood cross arms differ from standard designs used for low voltage work only in being wider and deeper with larger pin holes and wider pin spacing for the higher voltages. For voltages of 11,000 to 33,000, standard 2200 volt, six pin cross arms may be used by leaving the middle pin hole vacant and giving a pin spacing of 24 inches for the cross arm with a 12-inch pin spacing and 29 inches with the 14½-inch spacing, which latter arm is the standard recommended by the N. E. L. A. For higher voltages and permanent structures larger arms must be used, and a six by six inch arm 64 inches long, with 2½ inch pin hole, allowing 48 inches spacing, is recommended for voltages around 50,000. Standard solid arms can be used with special clamping pins and in such a case a size of arm 3¼ by 4¼ or 3¾ by 4¾ is satisfactory.

Fig. 44. Clamps made by W. N. Mathews and Bro., St. Louis, Mo.

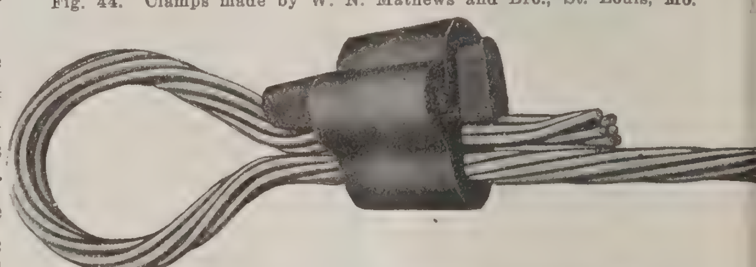


Fig. 45. Bierce Guy Clamp made by Specialty Device Co., Cinn., O.

Fig. 41. General Electric Company's Strain Insulators.

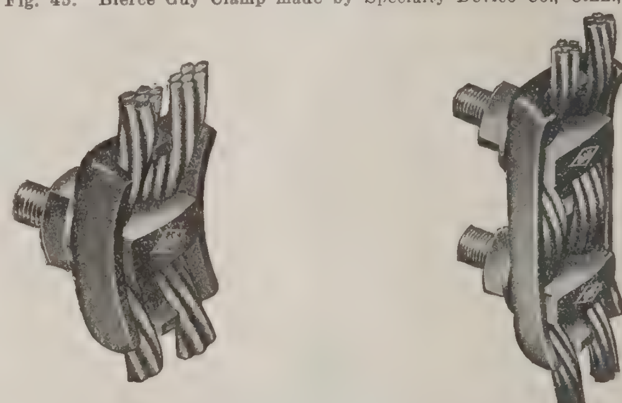


Fig. 46 Bolt Guy Clamps made by Barnes and Kobert Mfg. Co., New Haven, Conn.

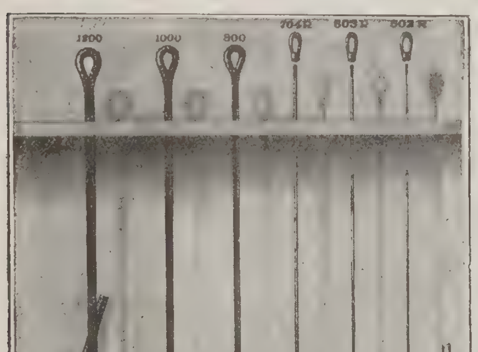


Fig. 42. Guy Anchors of Screw Type made by W. N. Mathews and Brother, St. Louis, Mo.

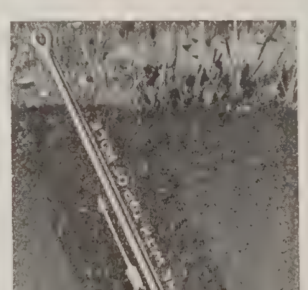


Fig. 43. Guy Anchor made by The Specialty Device Co., Cincinnati, Ohio.

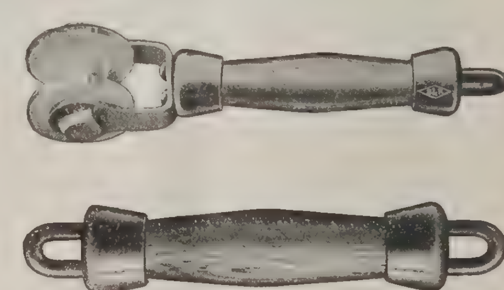


Fig. 47. Strain Insulators made by Barnes Kobert Mfg. Co. New Haven, Conn.

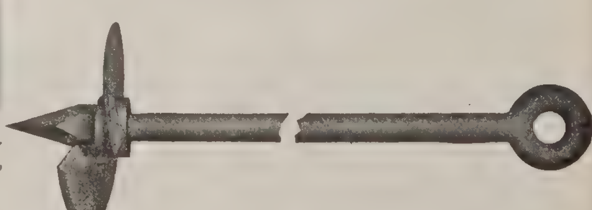


Fig. 48. Guy Anchor made by Hubbard and Co., Pittsburgh, Pa.

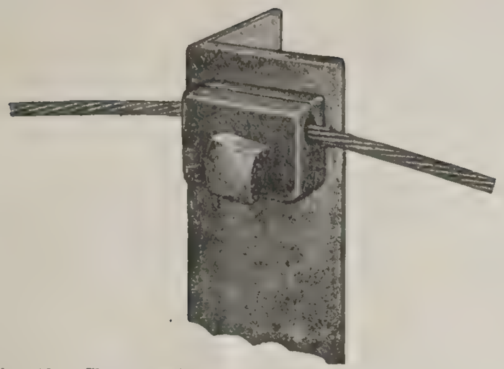


Fig. 49. Clamp designed by Electric Service Supplies Co., Philadelphia, Pa.

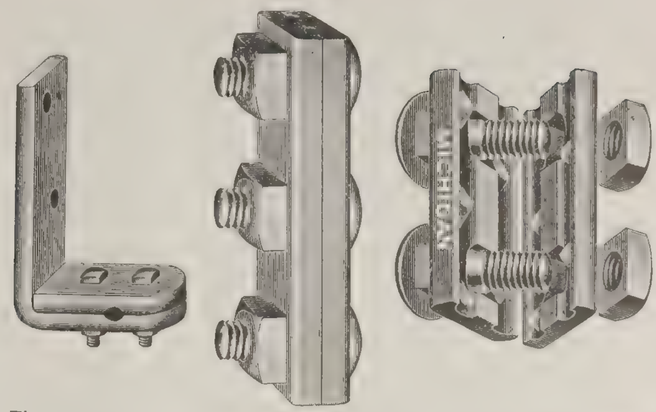


Fig. 50. Clamps made by Michigan Bolt and Nut Works, Detroit, Michigan.

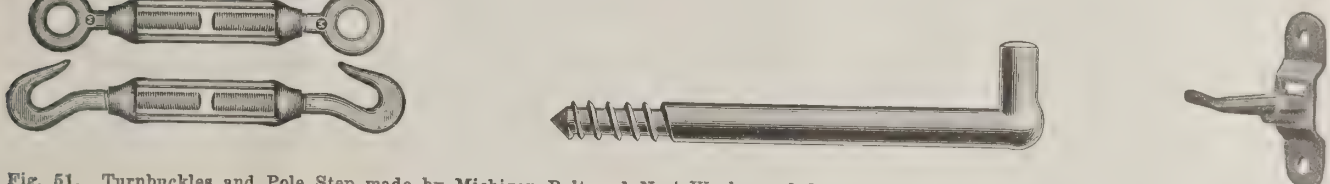


Fig. 51. Turnbuckles and Pole Step made by Michigan Bolt and N ut Works, and detachable pole step made by Barnes Kobert Mfg. Co.

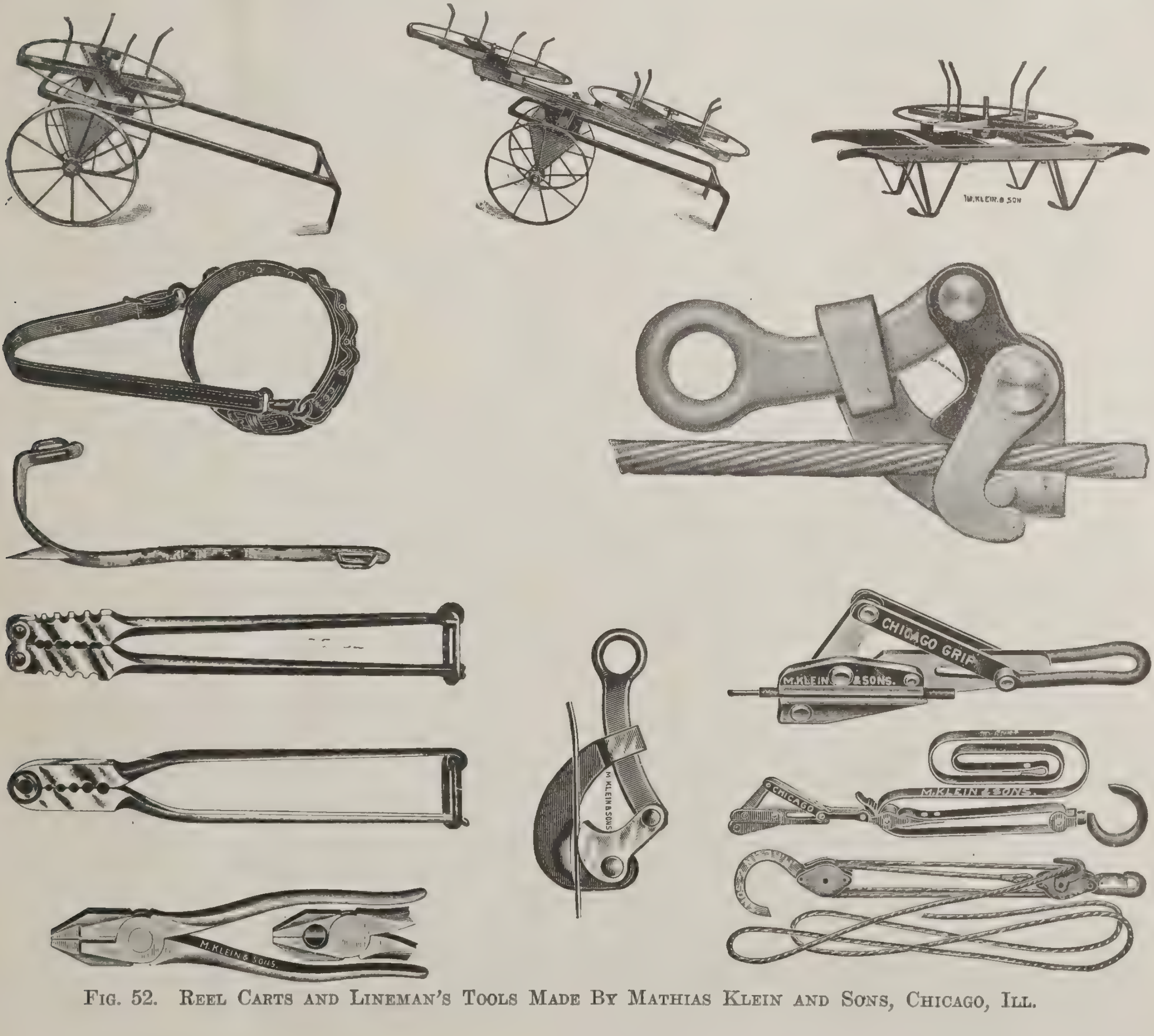


Fig. 52. Reel Carts and Lineman's Tools Made By Mathias Klein and Sons, Chicago, Ill.

The available sizes of arms are as follows, with the following dimensions: Standard No. 1, 3¼ by 4¼; Standard No. 2, 3½ by 4½; Standard No. 3, 3¼ by 3¾. These arms all have a distance between end of the arm and end pin, of four inches, and standard pin hole of 1½ inch. The bolt holes for fastening cross arms to the poles are usually ⅝ inches at the middle of the arm, with two ⅜ inch holes, 38 inches apart, for fastening cross arm braces in standard No. 2, and 40 inches apart in standard No. 3.

The types of metal cross arms, such as the Bow Arrow and others are shown in the accomponying illustrations, with dimensions.

It is now claimed that the different types of pins have little effect on the mechanical features of the insulator, since the latter is much stronger than the pin. That is, for an excessive load, the pin will break before damage occurs to the insulator. Metal pins, or a pin with a metal through bolt, while stronger than wood pins, when mounted on grounded arms or steel structures, carry ground potential into the pin hole of the insulator and increase the electrical stress on the insulator head, yet such is claimed to not be sufficient in well designed insulators to materially reduce the insulator characteristics. With wood pins, the electrical stress on the insulator is partly relieved, since a part of the dielectric strain is taken up by the wood.

When pin type insulators are used on high voltages, there is a certain leakage over the insulator to the pin which in some cases is considered responsible for the frequent charring and burning of pins. In other cases there is a peculiar destructive action not yet accounted for, which shows up a dry rot, causing the pin threads to crumble away and result in pin failure. Good life of wood pins can be secured, however, through the use of some good insulating compound, such as oil or paraffin. When glass insulators are used, wood pins are essential, or pins with steel shanks and wood thimbles, so that a cushion is provided between insulator and pin. This is required on account of the relatively low co-efficient expansion of glass, when all metal pins are used, and the danger of mechanical failure.

Pins of the wood type for a driving fit in cross arms, and of the bolt and clamp types are shown in the accompanying illustrations. For high voltage work the two latter types are most used.

GUY ANCHORS AND MISCELLANEOUS MATERIAL.

There are a number of patented designs of guy anchors on the market, including the screw type, the scoop type, or flat expanding plate type, the straight malleable iron plate "dead man," and harpoon designs. These anchors are shown in the accompanying illustrations. Other types of construction are best shown by the illustrations given here and need no description.

Electrical Progress & Developments for 1914

BY D. H. BRAYMER.

A Compilation of Opinions and Reports on Tendencies of Engineering, Manufacture and Installation of Electrical Equipment.

WHILE the large hydro-electric installations of this country and the apparatus which has been designed and installed to meet the conditions have created widespread interest and all reviews of advancement in engineering have called attention to the engineering achievements making possible high tension transmission over long distances, 240 miles now being the record, there is considerable interest being shown in the development of distributing facilities and equipment to make possible the serving of small loads and the connection of such to the main net works now covering large sections of this country especially in the South and West.

Central station consolidation and the interconnecting of high tension lines with the concentration of the power supply for a large territory from one system or several under a joint give-and-take contract, continues to add reliability and confidence in central station service. In sections where water-power is not available, the absorbing and emerging of plants so as to bring a large number under one management continues with financial, engineering and commercial advantages. A noteworthy illustration of such an arrangement is the Central Illinois & Public Service Company which now operates four modern stations and serves 100 communities formerly supplied by 50 separate generating stations.

In spite of the business depression prevailing during the past year considerable progress is to be noted in different manufacturing lines, however, as far as development of apparatus goes such has been confined to extensions of existing standards with no startling new discoveries or inventions. In commenting upon recent electrical progress Mr. Paul M. Lincoln, president of the American Institute of electrical engineers, has the following to say: "One thing that is perhaps most notable to one who has looked upon previous reviews, is that progress, particularly in things electrical may now be taken as a matter of course. If there is any branch of our industry which does not show progress, it is an immediate sign of decadence. If progress in any given line cannot be reported for this year, it is probable that next year's progress report will omit mention of it entirely."

Prime Movers—Steam Turbines and Waterwheels.

The tendency of a demand for generating units toward larger capacity seems to continue. There is now being installed by the Brooklyn Rapid Transit Company a 30,000 Kw. Westinghouse double unit turbo-generator which will be in decided contrast with the 10,000 Kw. unit which only a few years ago was considered extremely large if not a limit in the matter of size. The growth in size of turbo-generators has been a normal one due to the demand for large and more efficient units to take care of a rapidly increasing use of electricity in the home, office, store, factory, mill and farm. The largest single unit to be operated by

steam of the turbo-generator type has a capacity of 35,000 Kw. The main features of design are improvements and requirements of mechanical details, stronger bucket and wheel material permitting increased rotative and peripheral speeds and safeguards against the danger of excess speed resulting from misuse of apparatus by incompetent operators.

In the design and development of hydraulic turbines, considerable stress has been laid on high efficiencies and turbines have built which have shown under test, efficiencies ranging from 80 to approximately 94 per cent. The vertical shaft single runner, hydraulic turbine for low heads seem to be gaining ground over the multi-runner, horizontal wheel. Also the single runner type of unit has found increased application to moderate and high heads, so that the trend of present development in the field of reaction turbines seem to be in the direction of still greater application of the vertical single runner unit to all conditions of head and speed. There are cases where the horizontal shaft unit still affords good arrangement as in a plant where the layout of the power house requires overhead intake to the turbines and in cases where direct current generators must be used.

The development of high head hydro-electric water wheels of the impulse type such as the designs of the Pelton Waterwheel Company continues alone increase in size and in economy of water consumption. These high head wheels are largely used in the West. A standard line of generators has been developed for connection to the single overhung construction of waterwheel units known as the waterwheel type. Where sufficient power cannot be developed on one wheel, the double overhung type of construction is adapted and with this type of construction, units of 20,000 horsepower capacity have been developed and are in operation in California. Single units of the complete or self-contained type of waterwheel are in operation developing as much as 10,500 horsepower under 390 feet head.

Generators and Converters.

The generators for waterwheels must of necessity vary in design with speeds ranging from 50 to 600 revolutions per minute. Excitation is an important point now given consideration and safety considerations have led to the design of generators with comparatively high inherent reactance. While this has been obtained by sacrificing close inherent regulation of the machnie, it does not prevent good regulation of the system which may be accomplished by means of automatic voltage regulators. The ratings and capacities of generators are being held in keeping with the prime mover used in connection with them. Generators are now being rated largely on a maximum constant continuous rating which is not to be exceeded except during momentary peaks instead of strictly according to the station load curves as heretofore, with considerable overload capacity.

The protection of generators, transformers and switches in large stations is being taken care of by protective reactance placed in the generator leads, the low tension bus or the low tension transformer leads. By limiting the abnormal flow of current into a short circuit by the use of protective reactance, the generating system as a whole is relieved from the disastrous effects of such short circuits.

The arrangements for exciting generators especially in water power plants is coming to be considered a very important matter. The tendency is to use separate waterwheel exciter unit with the majority of present plants using this type as against an exciter direct connected to alternator shaft. It seems to be practice to install at least two units either one of which is large enough to take care of the excitation of the whole plant. The best argument for the isolated waterwheel driven exciter plant is that it offers a separate source of direct current for operating station auxiliaries, lights, cranes, pumps, etc.

Continued use of commutating poles on rotary converters has proved their usefulness. A 4,000 Kw., 600-volt, 25-cycle converter is now being built for the Interborough Rapid Transit Company in New York with a 300 per cent momentary overload guarantee. A 2,000-Kw., 270-volt, 60-cycle synchronous booster rotary is also being built for the Cleveland Electric Illuminating Company which will be the largest 60-cycle rotary of this type ever built. The most notable feature about these developments is the comparatively higher speeds that have been used over those formerly used. The use of commutating poles in the design of these machines has made not only this higher speed possible, but has produced better machines, it being particularly noted that the peripheral speeds of these machines are very little, if any, higher than the peripheral speeds used on the non-commutating-pole designs. Compensated windings have been effectively used in addition to comtating poles on generators, where subjected to very severe peak loads such as in large fly-wheel motor-generator sets.

Developments in Transformers.

Transformers are now being designed with higher reactance than formerly, 4 to 6 per cent being common. This feature permits them to limit the current output at times of short circuit and successfully withstand mechanical strain to which windings are subjected during short circuits. The practice of bringing out taps between the normal operating voltages so as to compensate for line drop is falling into disfavor. With the increased use of the small outdoor substations, outdoor installations of water cooled transformers are receiving considerable attention, especially where there is danger of freezing during cold weather. While transformers are in service there is no danger from freezing, however, precautions are necessary for cases of interruption of services and other abnormal conditions. Heating grids in the bottom of the tanks, or non-freezing oil is being favorably considered when the above conditions are met. Practice seems to indicate that the most economical voltages for distribution in connection with small outdoor substations, is around 22,000 to 33,000 volts. The transmission voltage of the Big Creek development of the Pacific Light & Power Company of 150,000 is now the highest in operation. However, this is not the limit, for much higher voltages are contemplated for new developments, and as far as constructing transformers goes this is altogether practicable.

Transformers of the self-cooling type are now being built up to 5,000 kva., capacity, of sheet steel, equipped with external radiators, made oil-tight by a welding process. The air blast transformer has also reached a maximum size in a 5,500-kva., single-phase unit in 25 cycle service.

A new development is the portable transformer substation consisting of a car 10 feet wide by 35 feet long

having mounted thereon three oil-insulated, self-cooled transformers with high and low tension switching equipment, and having a capacity of 4,000 kva. This compact arrangement is made possible by a forced draft through ducts around the base of the transformers.

Motor Developments and Various Applications.

A use of synchronous condensers for improving regulation is that of the 150,000 volt transmission system in California which requires two fifteen thousand Kva. synchronous condensers. In connection with the operation of this line a synchronous machine doubles the power rating of the line, the capacity of which is claimed to be 60,000 Kva. The use of the synchronous condensers makes the line a constant voltage one with no variation at any point for all loads up to 42,000 Kw.

The polyphase induction motor has to a considerable extent replaced the direct current motor in mills and factories requiring constant speeds. A particularly noticeable fact is the adoption of central station power by the steel mills, coal companies and railroads for work in their respective lines, the latter two particularly for work at the terminals. The Westinghouse Company alone, as a rough estimate has furnished equipment during the past year that will result in an output by central stations of 15,000,000 to 20,000,000 kilowatt hours of energy for this class of service, assuming normal business conditions.

During the past few years industrial plants have taken up the proposition of electric drives and both direct and grouped drive with electric motors seems to be gaining favor more and more. In the textile industry the electrical drive materially increases the production of the mill with the same machinery and labor. In the iron and steel industry there is still a decided field for improvement and application of electrical drive with considerable attention being paid to this matter. The irrigation field of the West and the use of motors for pumping is rapidly growing as transmission lines extend further into this field. The oil fields also call for applications of an interesting nature.

In the mining field locomotives are being extensively used with constant improvement in design. A promising field is developing in mining work for the storage battery locomotive, and some predict combinations of oil-electric, trolley and storage battery locomotives for industrial, as well as mining work.

The electric furnace, while an interesting application of electrical energy, is slow to develop. On certain operations other conditions being equal, the electric furnace shows a saving of 15 to 20 per cent in cost of heat alone, as compared with oil furnaces. Electrical welding is gradually growing in favor, and electric welding equipments are now in use in repair shops to repair broken machine parts and tools and in steam railway shops repairing broken wheels, cylinders, etc., in electric railway shops for welding motor frames, gear cases, building up worn rails and crossings, flat wheels and in steel mills for repairing broken parts.

The use of domestic devices has continued with increased popularity and no startling innovations have been brought out, but rather a general improvement and extension of existing lines. Among the improvements made by one company during the year may be mentioned a new five-cup coffee percolator, which brings this useful device into the reach of practically every one having electric service; an electric curling iron, a new electric iron with an efficient detachable rear connection giving perfect contact; an improved type of non-luminous heater, and an electric linotype pot for heating type metal for linotype machines eliminating the objections of gas, gasoline or kerosene heaters for this service and adding a new source of power for central station development.

The use of electricity in the automobile is one of the modern developments which has grown rapidly. At first, the only use that electricity found in an automobile was for the purpose of ignition. However, the convenience of electricity has won over the automobile field in a remarkable manner in the past few years. In these modern days, no automobile is complete unless the gas engine charges are electrically ignited, and it is equipped with electric lights, and an electric motor for starting the engine and electric devices for shifting the gears, and doing many of the things which formerly were done by some other means. Another development is the magnetic pinion shift wherein the starting motor is thrown in gear by means of a magnetic device instead of a manually-operated device.

Control Developments.

In industrial lines the development in methods of control has been mainly along along the lines of refinement. The Westinghouse Company during the past year has brought out alternating and direct current magnet switches, automatic starters, and controllers for use with various industrial applications, and improvements in reversing motor planer equipments. The company has also extended its line of industrial motors, including the polyphase and single-phase types, elevator motors, blowers of the Ventura type, and direct traction elevator motor and control, the latter meeting with marked success.

In the case of switchboards, progress has been made in the protection of circuits by means of improvements in relays and circuit breakers. An induction type relay operating on watthour meter principles that obviates troubles experienced with the bellows type has been brought out. This relay has a self-contained torque compensator, giving inverse time element on ordinary overloads, and definite time element on heavy overloads, or short circuits. The introduction of the reactive factor meter in place of the power factor meter, in other words, the use of a meter to measure the sine of the angle of lag or lead instead of the cosine, was made during the year. The meter is the same in principle as the power factor meter, but it enables operators to keep the power factor closer to unity than can be done with the older instrument.

In the design of oil circuit breakers themselves, no very great changes have occurred, but the year has seen much progress along the lines of following out the improvements which were commenced during 1913. The principal advance has been in the use of one piece cylindrical tanks with round bottoms for circuit breakers of heavy capacity, this obviously being the very strongest type of tank which it is possible to obtain. During 1914 several 24,000 ampere carbon type circuit breakers were put into service, these being the largest capacity circuit breakers of any kind ever built. Outdoor oil circuit breakers can now be obtained for any voltage from 13,200 to 165,000 electrically operated, at reasonable prices and in entirely self-

contained units for automatic operation and at the lower voltages with self-contained inverse time limit overload.

Electric Railway Development.

The adoption of electric traction for severe railroad service is now no longer an experiment. Locomotives have been designed and are now in operation which prove that electrical operation is economical and efficient. Decidedly interesting examples of electrification are the Butte, Anaconda & Pacific Railroad, using 2,400 volt equipment, and the recent equipment for the first section of the Chicago, Milwaukee and St. Paul of 113 miles of main line using 3,000 volts direct current apparatus. The service in both cases is severe and economies have been effected which speak very favorably of electrical operation. Direct current operation at potentials higher than 600 volts direct current is not now a serious consideration, for 2,400 volt operation has been successfully demonstrated. Polyphase operation is still limited to concatenated speed variations; single phase when carried out with commutator motors permits variation with a variable tap transformer, and with direct current speed variation to any essential degree is attained by grouping the motors. Polyphase operation seems to work out best at about 6,000 volts and 15 cycles, single phase operation at 11,000 volts at both 15 and 25 cycles. The development and perfection of the commutating poles series wound railway motors, together with the apparent possibilities of the mercury arc rectifier, offer a promise for successful introduction of higher direct current voltages in connection with railway work than has heretofore been practical or possible. It is expected that a trolley potential of at least 5,000 volts will soon be in use and thus make the distribution of power to locomotives or cars more efficient and economical.

In the matter of development, probably the pressed steel railway motor is the greatest contribution during the past year. This motor is said to introduce an element of all around economy in that a given number of sizes may be agreed upon to meet market conditions and thus become standard, eliminating the many types, shapes, etc.

Another recent development in electric traction which is important from a technical point of view is the so-called "split phase motor." This motor is not a new traction motor but a motor used as an intermediate step between the line and the traction motors and its function is to change single phase current into polyphase current. It is not a motor generator set but a straight induction motor run as a single phase motor with additional windings so interconnected that polyphase current can be supplied to the traction motor. This motor is kept running continuously and power supplied to polyphase motors only when the car is operated.

The polyphase induction motor because of its simplicity and ruggedness and the possibility of regeneration of power possesses ideal characteristics for heavy electric traction. The chief disadvantage is the complex distributing system necessary and the trouble in collecting current. The use of the split phase motor makes possible the use of polyphase motors with single phase distributing system. This system has been adopted on the Norfolk and Western R. R. over the Mountain Division in Virginia. The road is primarily a freight hauling road, traffic is heavy and speed low. This system is ideally adapted to these conditions and in this case proved cheaper to install.

Electric Lighting.

The development of the year in lighting units has been the perfection and standardization of the so-called "half-watt or high efficiency tungsten lamp." Sizes are now available for most commercial circuits of 1,000, 750, 500, 400, 300, 200, and 100 watts, with appropriate designs of fixtures. Since it is in only comparatively large sizes that there is the remarkably low specific consumption of 0.5 watts per candlepower, the first commercial development of these types is in connection with exterior lighting and the lighting of large interiors.

The efficiency of the gas-filled lamp increases with the diameter of the filament, thus making the high current lamp the first to be put on the market and we find them used extensively on the standard 6.5 and 7.5 ampere lighting circuits. With even better efficiency, lamps drawing a current of 20 or more amperes might be used on alternating current series circuits with a compensator or current transformer for each lamp. Another important class of work for which the new lamp seems peculiarly adapted is in projection lanterns, small search-lights and in all places where a steady light of high intrinsic brilliancy is desirable.

Although the gas-filled lamp may replace the present type of enclosed carbon arc, it is a question for the future to decide whether it can compete with the high efficiency arcs such as the magnetite and the quartz mercury lamps. While the efficiency of the new mazda is of the same order as that of these arcs, the cost of maintenance is a factor which may be of greater importance than the actual specific consumption of the lamp. It is probable then, that the extent to which the nitrogen-filled lamp will be used is largely a matter to be decided by the cost of manufacture and cost of maintenance of several of the better lamps of today, and the adaptability of each to special types of service.

Telephone Development.

Under present conditions of operating transmission systems, the telephone has become an indispensable part of the whole system. Considerable engineering work has been done in connection with providing safe and satisfactory telephone transmission when lines are run on the same towers or poles carrying high-tension power conductors. Apparatus has been designed and is in use, which makes this possible, however, the experimental stage in connection with the introduction of this equipment has not yet passed. The Georgia Railway & Power Company, of Atlanta, Ga., has a system which operates very satisfactorily and a number of devices have been put in operation, especially designed by their engineers. The secret of the operation of the above system seems to be in the insulation of the telephone system to at least 60,000 volts.

In the commercial telephone field, the development has been along the line of re-designing old apparatus and the filling in of new designs to meet new requirements. The developments in the apparatus manufactured by the Western Electric Company for the Bell system and other telephone companies includes a new type of equipment for central battery central offices. This switchboard equipment gives a form of semi-automatic operation by making use of an automatic ringing and automatic listening feature. Automatic ringing enables the operator, by merely plugging into the called-for subscriber's jack, to ring the latter's telephone bell automatically at regular intervals until the subscriber answers. The automatic listening feature elimi-

nates the necessity for operating a listening key, the circuit being so arranged that the operator's telephone set is connected to the calling subscriber's line as soon as the operator plugs into the answering jack. A distinctive feature is found in the fact that it is impossible to ring in the called-for subscriber's ear, as ringing current is cut off by a tripping relay, either during the ringing or the silent interval, the instant the called-for subscriber takes the receiver from the hook. Other features embodied in this equipment are the facilities for automatic peg-count and automatic recall, whereby either one of the talking parties can, by means of automatically operated apparatus, instantly call the operator on the line without depending upon the form of supervisory signals now in general use.

A new automatic ringing mechanism has been developed for use with these automatic ringing and listening equipments. This mechanism which is used to produce the ringing and silent intervals is of the clock work type, making use of a high grade, reliable clock movement. This type of machine is simple in design, and as trustworthy as a motor-driven ringing machine and interrupter. In order to maintain the minimum load on the apparatus that produced the ringing current, the mechanism is so arranged that only one-third of the switchboard is connected to the ringing current at any one time. This makes it possible to serve a greater number of switchboard positions than if all positions were ringing on the same interval.

As a further development in standardizing switchboard equipment, a universal type of multiple switchboard section has been produced. This can be used for any one of the following varieties of equipment:

Common battery multiple, partial multiple, multiple or partial multiple without answering jacks, lamp signal magneto multiple, lamp signal magneto convertible and magneto multiple or partial multiple using combined jacks and signals.

By standardizing frameworks in this manner, great flexibility is obtained. Equipments, in many cases, can be readily adapted to the various requirements prevailing in the telephone operating field.

Satisfactory designs of intercommunicating equipment is now available for office, home and factory use and developments are rapidly solving the problems in mines and in connection with railway operation. Development work in connection with mine telephones has been confined to the perfection of the mine rescue equipment. This equipment, which provides a reliable and flexible means of constant communication between a rescue party in the mine and a directing party at the surface, has been developed in collaboration with the Federal Bureau of Mines. The final design is such that it will meet successfully all the conditions that may arise in mine rescue work.

An efficient loud speaking telephone for railway train dispatching work has been produced after considerable development work. These loud speakers are used at the train dispatcher's office and way stations instead of head receivers. A mechanically held selector has been developed for way-station signaling service. This is a group type selector which does not require current during the ringing period, after it has once been operated, and is of considerable advantage in simplexing lines and furthermore produces a saving of battery current.

English and Continental Electrical Developments in 1914

BY R. E. NEALE, B. S. C. LONDON, A. C. G. I.

THE event which casts its shadows over all others this year is the outbreak of European war. On the Continent, where conscription is in force, mobilization has practically paralyzed industrial activity since last August but in this country, barring recruiting activity and special war editions, conditions are practically normal. It is hardly credible that so vast a war could upset so little the conditions and course of existence in this country. Credit is good and prices practically normal. There is no trace of any panic. Active measures are being taken officially and by private firms to capture a share of German trade. The German agent-firm is probably eliminated for years to come, leaving only those firms who have established works in this country. The German long credit system has been one of the most potent factors in securing orders for Germany in the past; but Germany will doubtless prefer cash trading for some time to come. In this country there is likely to be active cooperation between firms needing component parts, namely, lamp bulbs and caps, to establish a joint factory giving certainty of supply and the advantages of bulk manufacture.

Technical societies are continuing their work despite the war. The industrial committee of the I. E. E. has died an inglorious death, chiefly because the institution's membership includes those whose industrial interests are more or less conflicting and the institution cannot "take sides" under such circumstances. Problems involving conflicting interests will arise and must be solved and it would certainly seem that the industrial committee would have rendered valuable service in reaching the best compromise, as well as in dealing with broader problems. Early in the year there was labor trouble between wiremen and contractors but the war has suspended this and other domestic disputes.

THE CENTRAL STATION FIELD.

It is estimated that the present electrical connections in this country are at least 1¾ million kw. in the provinces and betwen ½ and ¾ million kw. in London. Electricity sales for all purposes are rising very rapidly but gas sales are practically stationary or even decreasing heavily. This experience is common also to most Continental countries. Increasing attention is being paid to the securing of small consumers. In small towns and villages the situation is complicated by more or less direct restrictions on overhead lines and often by existing gas competition. The latter is a serious factor in small, conservative communities with limited resources.

Generally, the effect of the war on central stations has not been noticeable. In many industrial centres the power load has increased and in residential areas curtailment of

holidays and amusements has kept up the private house demand. The nation's mood is certainly not to sit in darkness and cold. To quote one instance:—publicity work has been suspended in Sheffield since August owing to shortage of men, yet in August, sales were 800,000 units more than in August, 1913, and during the first week of October the increase was ¼ million units. Taking the country as a whole, central station reports are very reassuring and more favorable than the most optimistic would dared to have expected.

There is rapid increase in the number of stations supplying both d. c. and a. c. Even where d. c. is chiefly used, a. c. turbo-generators and high tension feeders are common for distribution to substations. Owing to too hopeful claims for efficiency, rise in fuel costs and breakage of delicate parts, there is rather a slump in the popularity of Diesel engines, but this can only be temporary. Among the Diesel engines installed or on order may be mentioned a 6,800 Hp. unit for London, 6,000 Hp. for Bremen, 4,500 Hp. for Naples, 4,000 Hp. for Belfast and 3,500 Hp. each for Hong Kong and Calais. Over 70,000 Hp. in units of 1,000 Hp. or over have been supplied for central stations by one maker alone. The first Ljungstrom turbine built in this country has been in use 18 months in a London station. It is a 1,000 kw. unit and averages 12.75 lbs. steam per kw. hr. on full load and 17.76 lbs. on quarter load. The guarantee of a 5,000 kw. unit now to be installed will be 11.8 and 15.9 lbs. on full load and quarter load and these figures will probably be bettered in service. The report of experiments on utilizing solar energy in Egypt is very favorable. The latest type of Shuman sun-heat absorber has 40% thermal efficiency. Such plant should prove very useful in the sunburnt areas to which its practicability is limited.

The problem of London's electricity supply (now provided by 15 municipal and 13 private undertakings) is still unsolved. Amalgamation is inevitable if supply is to be economically sound. Concentration of generation can be secured either by confining growth to the best existing stations (gradually converting others to substations) or by the drastic policy of erecting stations right outside the Metropolis. The military risk of the latter policy cannot be ignored and its immediate adoption would involve prohibitive scrapping. The financial problem is more serious than the engineering problem and the best course is to frame a complete scheme for bulk supply and make all extensions and alterations concordant with the ultimate aims. Administrative energy and balance should be best secured by forming a holding company, part of the capital being put up by the municipality which would then share profits. The risk of purely municipal control was exemplified in Leeds where, as a result of labor trouble investigations, it was found that modern plant and reorganization reduced the staff in the gas department alone by 500, saving $180,000 per annum. At present gas supply is far more centralized and better organized than electricity supply in London.

Electricity sales by municipal stations in London are over 50 per cent of private sales and have increased 125 per cent during the last 6 years as compared with 35 per cent increase in companies' sales; corresponding capital expenditure has increased 20 per cent and 13½ per cent. The uncertainty of tenure of company concerns has crippled their activity. Average selling prices for street lighting, private lighting and power are respectively 3.04 cents, 6.3 cents and 2.06 cents in municipal and 2.86 cents, 7.1 cents and 2.5 cents in private undertakings, the combined averages being 3.94 cents and 5.16 cents and the highest municipal average 6.34 cents as compared with 9 cents, the highest company average.

Municipal concerns have done more than the companies for small consumers and short hour demands. A particularly interesting example is the London suburb of Wimbledon where the local authorities have arranged for a company to undertake the supply to unwired property at a fixed price per lamp (from 5 cents per 25 candlepower lamp per week in summer to 12 cents per 100 candlepower lamp in winter). Special non-interchangeable lamps are used and a cheap outside wiring system from central station boxes in each street. Small houses and shops have been secured in large nmbers. The central station is relieved of all wiring and bill collecting duties and charges. Hiring-out powers are possessed by 80 towns in the country but are seldom utilized; where municipalities endeavor to work a wiring and fitting department disputes with contractors have been bitter; the position is still far from settled but there are signs of reasonable settlement by consent.

INDUSTRIAL APPLICATION.

The announcement just to hand of the decision to propel electrically the U. S. A. super-dreadnaught "California" has aroused intense interest and the liveliest satisfaction in electrical circles in this country. It is recognized from the splendid performance of the "Jupiter" that marine electrical propulsion is a proven system and one which will open a huge field to electrical manufacturers. Shipowners literally cannot afford to ignore the great saving in prime and working costs effected by Durtnall's system of propulsion. In other heavy electric power fields there is nothing radical to report; in mining and iron and steel works, electric motors and electric furnaces make good steady progress along known lines and in lighter services the use of electric motors in preference to or in substitution for small gas engines is rapid and widespread at home and on the Continent. To quote only one example, gas sales for gas engines in Manchester increased 3 per cent from 1909 to 1914; during the same period the sale of current for motors increased 155 per cent. One interesting foreign development has been activity in the application of electricity in Roumanian oil fields.

At Liverpool a high tension alternating current method of sterilizing milk is in regular use at the Corporation milk depots. Flow through the lethal tube occupies only a few seconds during which the milk is subject to 2 to 2¼ amperes at 4,000 volts. Over 99.9 per cent of the bacteria is destroyed and no harmful bacteria are left. From 100 to 125 gallons per diem are treated at the chief depot, particularly for infant nurture.

ELECTRIC TRACTION.

A number of suburban and short distance main line electrification schemes are in progress in this country, their number and extent are eminently satisfactory. The number of different systems employed is not so serious as sometimes alleged because main line traction will undoubtedly be by locomotive and to change locos at a few important

junctions is quite an ordinary matter. Through-running is allowed for in suburban systems.

The *systeme de traction auto-regulatrice* employed on the Paris Metropolitan Railway marks an important advance in direct current traction motor control. A constant current reversible booster is used which permits regenerative working and effects 20 per cent saving in energy as compared with series-parallel control. The first electric railway in Spain (Gergal de Santa Fe) is interesting in that it was prescribed by the necessity for relieving congested heavy mineral traffic on severe gradients. Three phase working is used to permit regeneration, trains run in pairs (up and down), the station supplying little energy except during starting. Electrification has increased the speed of ascent from 7½ to 15½ m.p.h. The highest direct current traction pressure in Germany is 1,500 volts at Wendelstein. A large buffer battery is used as also is the case in the l'Albt and Wiese valleys where accumulators in conjunction with converters smooth the load satisfactorily on a single phase system.

Important electrification schemes are on foot in India. At Bombay 180 miles of suburban line is to be electrified on the high tension overhead direct current system, this being chosen to permit through-running with the Poona mountain and tunnel lines which are likely soon to be electrified. Increased traffic and the limited boiler-capacity prescribed by the narrow gauge cause serious congestion on the suburban lines and some main lines from Calcutta. It is proposed to use electric locos on the main lines with accumulator locos on works sidings, etc.

The use of commercial electric vehicles is now making good progress in this country. The battery bus is ideal in point of traffic flexibility and value as central station load. Single deck buses with Edison cells are used at Southend, South Shields and York; lead cells are used at Brighton, maintenance being by makers on a mileage basis. The heavy London tramways deficit is attributable to high capitalization; low fares economically unjustifiable; handicap of being unable to reach central areas; and ever increasing 'bus competition.

THE LAMP SITUATION.

The present shortage of arc carbons is all in favor of half watt lamps but reduced lighting in all large towns (for military reasons) is against all high candlepower lamps. The price of half watt lamps has been reduced and relatively low candlepower high voltage units are now available. The largest and smallest regular sizes of 200-230 volt lamps are 1,500 and 500 watts but much smaller sizes are being tested out by manufacturers with satisfactory results. The mutual licensing of each other by three leading lamp makers under all patents held individually has much simplified the lamp position.

COOKING AND HEATING.

The relatively slow progress in electric heating and cooking in this country is attributable chiefly to the cost of wiring and of purchasing apparatus (purchase being the only alternative to hiring-out, which is not always possible here) and to the imperfect design of apparatus at first marketed. Recently there have been great improvements in efficiency and in wiring, insulation and terminal construction. More energetic measures have been taken by central stations and the Point Fives Association (engineers supplying heating current at 1 cent per unit) has extended the number and influence of its membership and the results of its work. It is noticeable that heating and cooking apparatus (like electrically driven domestic power apparatus) is installed chiefly by middle class householders.

Practical Methods for Laying Out and Building Transmission Lines

BY E. B. HOOK, JR., SUPERINTENDENT OF CONSTRUCTION, GEORGIA RAILWAY AND POWER COMPANY.

THE actual engineering and preparation essential to the design and construction of a transmission line deserves more attention than has usually been given to it in the past. After the general character of the line has been decided upon, the various conditions upon which the construction will depend and be influenced, must be taken up and each and every detail carefully designed. In large systems where hydro-electric developments are the source of power, the line usually extends over a considerable distance of rough, unsettled country, and is subject to all kinds of disturbances which may be caused by lightning, sleet and windstorms, or any number of other troubles. When these disturbances result in an interruption to the service, the generators, transformers and other power house and substation apparatus are, of course, useless until the line is put back into service. Sometimes these "knock-outs" are caused by failure of insulators and burning off of the conductors, and often considerable time elapses before the trouble is found and repaired. Therefore, the importance of detail engineering of transmission lines is readily understood and should be duly stressed.

In what follows the methods that have been found by the writer best suited to the laying out and building of transmission lines will be taken up. A specific line which has been constructed will be used as the basis of the discussion and certain points of interest taken up which in some cases were encountered in the construction of the line referred to, together with others which may be met with in the construction of other lines of the same general character.

The first step preparatory to the construction of any type of transmission line is the making of a map showing the main points between which the line is to be built. This map should be laid out on a scale convenient to handle in making the preliminary investigations in the field, but still be large enough to show clearly for office work all towns, villages, roads, rivers, creeks, railroads, bridges and existing telephone or telegraph lines in the intervening territory. In the making of this map, county plat books, atlas sheets or government topographic maps will be found very useful, though sometimes discrepancies occur on account of recent changes in roads, etc.

The engineer should thoroughly familiarize himself with the territory and general lay of the land, noting carefully

such towns and villages, or industrial enterprises that may develop into future customers, and all other features that have a bearing on the location of the line. He should sketch several proposed lines on the map, and make a preliminary survey of each of these lines. Notes should be made by the surveyor of all roads radiating from railroad stations giving access to the line. This information will be of service in determining shipping points for construction material and maintenance of the line when built. When several routes are surveyed, there is less tendency on the part of farmers and land owners to oppose the construction, and to ask unreasonable prices for right-of-way easements.

Naturally, from an economical standpoint the shortest, practical route is desirable but it is well to take advantage of roads and highways paralleling the general direction of the line, and whenever possible to run along section lines and natural division lines. This pleases the farmers, and right-of-way will be much cheaper and more easily secured. It pays well to adhere strictly to a policy of absolutely fair dealings in all transactions with residents along the line. Cultivate their acquaintance, and gain their good will, and the company will be amply repaid by the friendly assistance that they will render in the future.

A complete private right-of-way throughout the route is very desirable. The first cost will be higher than when a portion of the line is built under county franchise along the roads, but the county commissioners can at any time have the line moved back if they desire to widen the road and if they wish they can order the line completely removed from the county property. When the line runs through well settled country with good farm land and growing crops, it is a wise policy, for obvious reasons, to construct the line when possible, after the crops are gathered.

STEEL VS. WOOD POLE CONSTRUCTION.

When the proposed route has been selected and the right-of-way easements secured, the engineer is prepared to decide upon the type of construction best suited to the conditions. In the instance of the specific line referred to at the beginning of this article, the general lay of the land was fairly flat, with some rolling meadows, soft bottom lands, cultivated farms and wooded tracts of pine and oak.

We have available for conductor supports wood, steel and to a certain extent, concrete poles and steel towers of various designs according to required height and strength. Steel construction has never been widely used except for important, high potential lines on account of the reputed excessive first cost. Recently, however, a decided change in policy has been noticeable in many companies, especially those using both steel and wood. Lower priced labor is possible with steel constructed lines than with pole lines, and with the number of patented steel poles and semi-flexible towers now on the market, and the steady decrease in quantity and quality of wood poles available for heavy work, the cost per mile of the completed steel line compares very favorably with that of wood.

On the other hand, there are certain conditions which make the use of wood poles very popular, particularly the creosoted long leaf yellow pine pole. If for example, soft bottom lands, marshes or swamps are encountered, the poles can be "rocked in" at very little more than the cost of setting in dry ground, whereas extensive cribbing and footings would be necessary for proper tower anchorage, and the cost would, of course, be materially increased.

It is apparent, therefore, that all practical classes of construction should be thoroughly considered with the actual conditions prominently in view, and estimates made under the existing conditions. This is an important point which is frequently overlooked, and one of the reasons why many estimates fall far short of the actual cost. Another important point which greatly influences the construction cost is local labor conditions. These conditions are often assumed to be the same in different localities, but are in fact a materially variable factor.

With this knowledge of the route, the most suitable type of construction, the influence to be expected on account of labor conditions on labor and field expenses, and the data regarding necessary material, height of poles or towers, size of conductors, number of circuits and length of span, we well now proceed to build a single circuit, three phase, 22,000 volt transmission line, and a private telephone line on the same poles.

CONSTRUCTION OF A 22,000 VOLT, 3-PHASE TRANSMISSION LINE.

The line conductors shall be No. 1/0 B. & S. gauge, hard drawn stranded copper cable of seven strands, and have an ultimate tensile strength of 60,000 pounds per square inch. The cross arms are to be of galvanized angle iron, of the wishbone type, with an angle iron bayonet for carrying the ground wire, the arms to be fastened to the pole with a ¾ inch U bolt. The insulators are suspension type composed of two units of 10-inch disks designed for a normal working voltage of 11,000 volts each. Poles shall be Class A, 50 ft. creosoted long leaf yellow pine, commercially straight and reasonably free from knots and cracks. The overhead ground wire is of 5/16 inch galvanized steel strand attached to bayonets with Belcher wire clamps. All pole hardware is to be galvanized. No. 12 B. & S. hard drawn copper wire will be use for telephone circuit, standard 2 pin cross arm and porcelain pony insulators, standard braces and fixtures. The telephone shall be transposed at every fourth pole by means of a suitable transposition bracket.

The life of wooden poles vary with the kind of timber, the climatic conditions and the particular location in which they are used. The average life of white cedar is generally assumed to be about ten or twelve years, and is probably the most commonly used pole timber. Chestnut poles are also in general use and have an average life of twelve or fifteen years. Treated poles of various kinds will have an average life of twenty years, but there is no reason why this should not be materially lengthened if the treated poles are properly cared for and given a fresh coat of preservative at the ground line about once a year. The subject of preserving treatment of poles and wooden cross arms has been investigated to some extent by various engineering bodies, and a great deal of information has been published on the subject by the companies manufacturing the preservative. Some of this information is conflicting, but there can be no doubt that a good preservative does retard decay if the pole or cross arm being treated is well seasoned and thoroughly dry, but if the wood is not thoroughly seasoned before receiving a brush treatment, the moisture contained in the wood is practically sealed within, and after a short time the outer coating of the wood

becomes torn away and fungi are admitted to the interior, thereby hastening decay.

Hot brush treatment at the ground line and at roof, gains and knots is very good, inexpensive practice when white cedar or chestnut poles are used, but in the case of long leaf yellow pine poles, which are known to be of shorter life, the vacuum pressure process is recommended. In this process the whole pole is put into a large retort or vat, and subjected to a live steam bath at a pressure of about 20 pounds per square inch for several hours. After the steam is blown out, a vacuum is created and the preservative pumped in until the desired amount has been injected. The remaining fluid is then drawn back into the storage tanks, and the timber allowed to drip for a few minutes before the doors are opened and the pole withdrawn.

The next section of this article will take up pole stresses and spacing.

Operating Advantages When High Tension System Has Neutral Grounded

BY MESSRS. JOLLYMAN, DOWNING AND BAUM.

BASED on an experience covering practically all phases of operation in connection with a modern high tension net work with grounded neutral, it is the opinion of engineers with the Pacific Gas and Electric Company that it would be impossible to give as good service with as high a degree of safety to the public with any other system. It is also maintained that with the grounded neutral there is less disturbance in telegraph and telephone lines than would be the case in delta connected lines. In what follows, the reasoning on which these conclusions are based is presented, abstracted from a paper read before the A. I. E. E. at Pittsfield, Mass., last May.

The Pacific Gas and Electric Company operates an extensive 60-cycle transmission network in Central California. The 60,000 volt system comprises about 1,260 miles of three-phase circuit, supplied directly by nine hydroelectric plants having an installed generator capacity of 67,310 kw. and three steam plants having an installed turbo-generator capacity of 68,000 kw. In addition there are 14,300 kw. of steam engine-driven generators in the company's steam plants which are held in reserve. The 100,000 volt system which was put into operation during the past summer, has one hydroelectric generating station of 25,000 kw. capacity and 109.5 miles of circuit. The entire output is fed into the 60,000 volt system through one substation.

For the purpose of the receipt or delivery of power the 60,000 volt system is connected as follows: at Chico to the 60,000 volt system of the Northern California Power Company; at Santa Rosa with the 60,000 system of the Snow Mountain Water and Power Company; at a point near Folsom with the 60,000 volt system of the Western States Gas and Electric Company; and at Oakland, through transformers, with the 100,000 volt system of the Great Western Power Company. These connections very considerably increase the length of circuit and total generator capacity connected to the 60,000 volt system. The entire 60,000 volt and the 100,000 volt systems are usually operated in parallel.

The transformers at all the company's own generating stations and at all important substations have their high-tension windings Y-connected with the neutral solidly grounded. The low-tension windings of the generating station transformers are nearly all delta-connected as are also about half of the substation transformers. The remaining substation transformers have both windings Y-connected with solidly grounded neutrals. In most of the substations where the low tension windings are delta-connected, a switch is provided between the high-tension neutral and the ground, which is normally kept open. This avoids the short-circuiting of one transformer in case of a ground on the transmission system and prevents the substation being cut off from the system by the opening of the protective devices on the high-tension side of the transformers. There are over 225,000 kw. of 60,000 volt transformer capacity in the company's own generating plants and substations.

The Northern California Power Company, the Snow Mountain Water and Power Company and the Western States Gas and Electric Company operate their transformers Y-connected with the neutrals solidly grounded. The connection with the Great Western Power Company is through transformers connected delta to delta. This method of connection is not theoretically correct where power is to be fed from the delta-connected transformers into the grounded Y system, because a ground on one wire of the line connecting the delta-connected source of supply with the grounded Y system will impress 173 per cent of normal voltage across the high-tension windings of two of the transformers in the grounded Y banks. The resulting disturbance in the low-tension circuits is very severe. Experience proves conclusively that this method of connection is not desirable.

At all generating stations, and at all important junction points and substations the 60,000 volt lines are connected by oil switches. The lines are switched out under any condition of load or short circuit as occasion demands. The lines are also switched on at full voltage. We have operated in this manner for over 10 years and have never had any failures of transformers or of line insulation which could be attributed to this method of operation.

We consider that the grounded-neutral system as compared with the delta system affords the following important advantages:

1. *With Regard to Transformers:* Transformers are wound for only 57.7 per cent of the voltage required in the delta system. The average voltage to the neutral from all points of the windings is 50 per cent of the voltage from line to neutral; that of a delta bank is 69 per cent. The product of the turns times the average voltage to neutral in the Y-connected bank is 41.8 per cent of that in the delta-connected bank. The windings have 173 per cent the current capacity of a delta transformer. In addition there is only one line terminal per single-phase transformer, wiring

for a spare unit is much simpler and the high-tension windings may be used as auto transformers in supplying small amounts of power to lower voltage circuits.

The connection between the Pacific Gas and Electric Company's 100,000 volt system and the 60,000 volt system is made with auto-transformers connected grounded Y. We believe this to be the simplest, most reliable and most efficient connection that can be made between two such systems. Our transformers have given so little trouble that we have not had much occasion to try to maintain service with only two transformers. We have had no difficulty, however, in carrying loads up to 2,000 or 3,000 kw. with two transformers. Our experience confirms our belief that the fewer turns of greater current capacity and the fixed lower average voltage to ground of the transformers greatly increase their reliability.

2. *With Regard to Transmission Lines:* The maximum voltage on the line insulators is fixed and is never more than 57.7 per cent of the line voltage. Ten years ago the pin type insulator was the only type obtainable and the low fixed maximum voltage of the grounded neutral system has unquestionably been of great assistance in securing the best service from this type of insulator.

It is possible to maintain polyphase service at a substation on a branch line with only two wires in the event one wire should be cut out. This cannot be done on a delta system unless one phase of the whole system be grounded and this is very undesirable.

3. *With Regard to Operation:* With the neutral grounded, a wire down is instantly detected and power must be immediately cut off. This is exceedingly important where many of the circuits run through thickly settled districts. Inasmuch as practically all our important loads are reached by two lines or are on a loop, service is only momentarily interrupted by a failure at one point.

A line of any length may be charged at full voltage without shifting the static neutral. It is impossible to close all phases of a circuit at exactly the same instant. In a delta system the first phase closed will increase the capacity to ground of that phase of the system and thereby draw the static neutral toward that phase. The second phase acts in a similar manner and the static neutral does not return to the center of the delta until the three phases are closed. This sudden shifting of the static neutral is the cause of an unnecessary strain on the insulation of the system. We know of failures from this cause on delta-connected systems.

Finally, and most important of all, is the fact that in extensive high-voltage delta-connected systems a ground is often followed by a disturbance of such power that breakdowns of insulation at other points take place. Such a disturbance generally results in serious damage to apparatus and service. The cause of this type of disturbance is found in the oscillatory character of the arc which takes place from a delta-connected system to ground, together with a large amount of current which will flow in such an arc if the system is extensive. In the event of a ground on a delta-connected system, the charging current, which is a function of the voltage from wire to neutral, will be increased because the neutral is shifted from the center of the delta to one corner. This increase will be about 73 per cent. The current flowing in the arc to ground may be nearly equal to the increased charging current, and this on our 60,000 volt system would amount to about 400 amperes. The circuit containing the arc, line reactance and capacity from line to ground tends to oscillate. Such an ocillating arc is very likely to set up disturbances of high power especially when there is any such current as 400 amperes involved. We have seen evidence that such a disturbance may cause high voltage to ground on the wire on which there is an arching ground. This fact would probably cause the operation of an arcing ground suppressor to be very unreliable.

Certain districts in which we operate occasionally have heavy fogs which are carried in from the Pacific Ocean by the prevailing westerly winds. It has been our experience in these districts that lines on pin insulators have given better service when operated grounded Y at 60,000 volts than when operated delta-connected for a much lower line voltage. It seems probable that the leakage over the insulators in foggy weather was sufficient to set up oscillatory disturbances which caused more trouble than has the higher but more stable line voltage.

We have found that the grounded Y system is entirely free from such disturbances as these. The frequency of an arc to ground is that of the system. Any damage is confined entirely to the point of failure. The short-circuit currents have not caused any damage to generator or transformer windings. Due to the distribution of the sources of power, any given point on the system will have a good many miles of line between it and several of the generating plants. Hence it is doubtful in many cases if more current would flow in a short circuit to ground than would flow to ground if the system were delta-connected. The drop over the lines from the more remote generating plants to a point at which a ground may take place serves to prevent the voltage at points removed from the trouble from dropping to zero, and therefore the service is not seriously interfered with except in vicinity of the trouble.

We believe that the operation of our system with the neutral grounded causes less disturbance in the circuits, of our neighbors, the telephone and telegraph companies, than would be the case if we operated delta-connected. Briefly, the induction in parallel telephone or telegraph circuits is caused by any unbalanced currents in the phases of the high-tension circuit, and by the presence of voltage to ground on the line conductors. The last cause is by far the most important because the unbalanced currents during normal operation may be kept very small while the voltage to ground is always high. A ground on the grounded-Y system will not cause much, if any, more current unbalanced than will a ground on a delta-connected system. The unbalanced current is at normal frequency in the grounded-Y system in place of at a very much higher frequency as is usual on the delta-connected system, hence the parallel circuits are not affected so unfavorably. It is our experience that even a considerable amount of unbalanced current at the normal 60-cycle frequency has little noticeable effect on parallel telephone circuits. The unbalance will be immediately removed from the grounded-Y system in all cases, whereas a delta-connected system may occasionally be operated a short time with a ground before a final shutdown takes place. The definite limit on the voltage to ground is of very great advantage to the parallel circuit.

The operation of our high-tension network with the grounded neutral has been entirely satisfactory. We do not believe that we could give as good service, with as high a degree of safety to the public, with any other system.

Installation, Operation and Maintenance

This section is devoted to practical suggestions, experience and data, and is open to all readers who have something to say on every day work and trouble in the plant or sub-station, on the line, in the factory, mill or elsewhere.

Standard Specifications for Red Cedar Poles.

In view of the consideration that the Overhead Line Committee of the National Electric Light Association, is giving to the adoption of standard specifications for red cedar poles for electric distribution, telephone and telegraph, the official specifications of the Western Red Cedar Association for poles of this material are of particular interest. These cover poles from four inch top, twenty feet and upwards as follows:

Top (inches)	*Circumference (inches)*
4	12
5	15
6	18½
7	22
8	25
9	28
10	31

Crook: No pole shall have more than one crook, and this to be one way only, the sweep not to exceed one inch to every six feet in length. Same to be determined in the following manner: Measurement for sweep (that part of the pole when in the ground, six feet, not being taken into account when arriving at sweep) tightly stretch a tape line on one side of the pole where the sweep is greatest, from a point six feet from butt to the upper surface at top, measure widest point from tape to surface of pole, and if, for illustration, upon a thirty foot pole this does not exceed five inches, the pole comes within the meaning of these specifications.

Butt Rot: Butt rot in center, including small ring rot, shall not exceed 10 per cent of the area of the butt. Butt rot of a character which impairs the strength of the pole above the ground is a defect.

Knots: Large knots, if sound and trimmed smooth, are not a defect.

Dead or dry streaks: A perfectly sound, dead or dry streak shall not be considered a defect when it does not materially impair the strength of the pole.

The National Electric Light Association, at its convention in 1911, adopted specifications for overhead line construction which, wherever possible in accord with local legal requirements, have become standard. These include eastern white cedar poles but the contingent stipulations therefor cannot consistently be employed for western red cedar. The eastern product tapers far more rapidly throughout its length, and is wind twisted, this latter necessitating the clause of one complete twist for every twenty feet of pole. From the first noted, it is readily seen that the accordant butt specifications would not be applicable to western red cedar, while further, the western pole is rarely wind twisted, being found in canyons and flats, well protected from the winds.

Referring to other western timbers used for poles, recent tests by the Forest Service show some interesting results in strength of the different materials:

Pine poles: Lodgepole pine poles, air seasoned, cut from live timber in Montana were found under test fully equal in strength to cedar poles. In actual stress developed they were superior, but on account of the greater taper of the cedar poles such advantage was lost in a comparison based on equal top diameters.

Cedar poles: Cedar poles were found superior to pine and spruce poles cut from a fire-killed area in Colorado, in maximum load developed. The three shipments noted, however, were practically equal at the elastic limit. Were the native poles to be used in place of cedar without any change of specifications, the factor of safety would accordingly be reduced one-fifth for conditions at failure, but would remain the same for stresses at the elastic limit.

Fire-killed pine poles: Fire-killed pine, after standing ten years, did not show deterioration to any noticeable extent when compared to seasoned lodgepole pine cut from trees in Wyoming and Colorado. The advantage in strength of the lodgepole pine poles from Montana can be accounted for by the fact that it was above normal in weight for lodgepole pine from the southern part of its range.

Ratio of strength: The ratio of strength of the poles and the strength of the clear material cut from them is not constant for the different kinds of wood. The "efficiency" factor varied from 0.74 to 0.48 of the strength of the clear wood when the comparison is made as tested, and from 0.98 to 0.65 when compared on the basis of values estimated to represent the same moisture conditions in the smaller sections as existed in the poles when under test. The values were highest for the cedar and lowest for the spruce, the pine representing an average for the three different specimens of materials.

L. R. W. Allison.

Wiring Suggestions for Grounding Secondaries.

All secondaries feeding from high tension alternating current distribution should be grounded. The grounding may be effected either on the pole line or within subscriber's premises, and in some cases it may be advisable to ground the secondaries both within the consumer's premises and also at the transformers on the pole line. The ground connection should always be made at a neutral point of the secondary system if such is available. Fig. 1 shows the transformer connections in ordinary use and indicates the points at which the ground wire should be connected.

The usual practice of central stations is to make the ground connections at the transformers and to carry them down the poles to earth. This is preferable to grounding within a subscriber's premises because if the ground is made on the pole line it can always be readily inspected and is under the company's control. Where the ground wire is of copper, nothing smaller than No. 6 should be used, but it is the practice of some companies where copper wire is used to put in nothing smaller than No. 4. Probably from an electrical standpoint wires of smaller diame-

ters would be ample, but any wire smaller than No. 6 is too weak mechanically to afford adequate permanent protection.

The usual practice, however, is to use stranded galvanized steel guy wire for the ground wire. Conductors of this material are so strong that it is almost impossible for them to be broken by linemen working on the poles, but iron wire always has the disadvantage of excessive corrosion. An iron wire has the unfortunate faculty of rusting asunder at the ground line and may under such conditions fail to give protection when it is most needed. To eliminate the possibility of an iron wire rusting at the ground surface, it can be protected at that point by a pipe

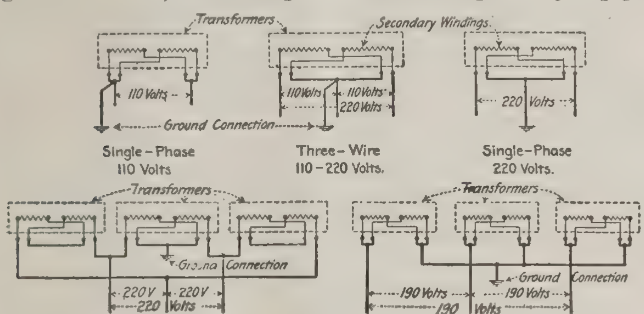


Fig. 1. Methods of Connecting Ground Wires to Transformer Secondaries.

driven into the ground as shown in Fig. 2. This pipe not only reinforces the ground wire but it effects a connection with the earth. The galvanized guy wire may be soldered into the top of the pipe as suggested in Fig. 3.

Some companies make it a practice of grounding their secondaries on water pipe systems. One good method of doing this is to carry the ground wire from the transformer down the face of the pole, and then along under the surface of the ground at a depth of a couple of feet as shown in Fig. 4, to a fire plug. At that point the ground wire is brought again to the surface and connected under one of the bolts of the fire plug as shown.

All ground wires at poles should be protected for a distance of at least 7 feet from the ground by a length of wooden molding. If this is not done it is possible that a person standing on the ground and resting against the ground wire may receive a shock—sometimes fatal—under

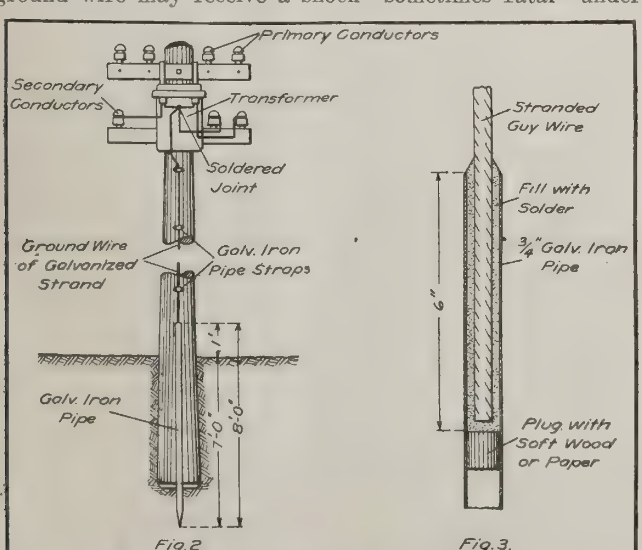


Fig. 2. Secondary Iron Pipe Ground on a Pole. Fig. 3. Method of Soldering Ground Wire in Pipe.

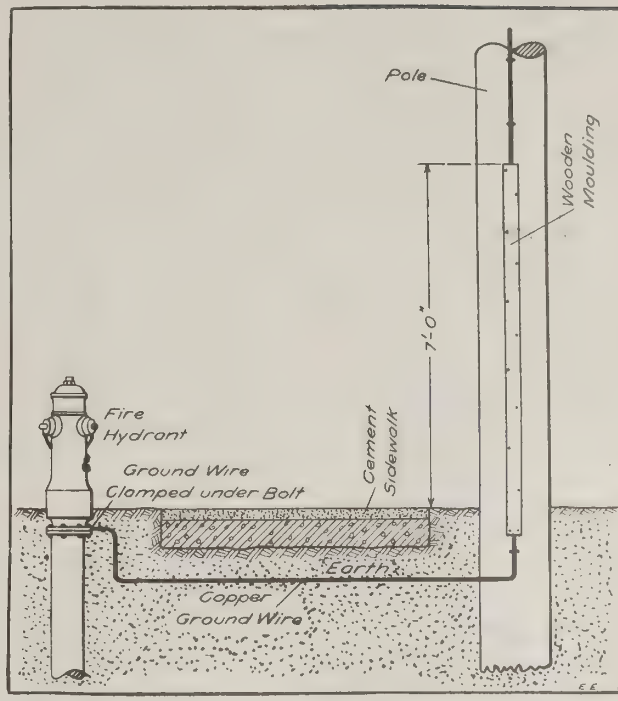


Fig. 4. Secondary Grounded on Fire Hydrant.

certain conditions. Ground wires can be attached to the poles either with pipe straps or staples, preferably the former, because if staples are driven in too tight they may cut or break the wire. As to the number of grounds required for a system; the approved practice is to provide one ground on the secondary of each transformer or group of transformers, and in addition in the case of a secondary network, there should be a ground at least every 500 feet.

Where secondaries are grounded within a building, connections are usually made to one of the pipes of the water supply system and the same precautions should be followed as those outlined in the National Electrical Code for grounding metal conduit systems. The connection to the water pipe should be made with an approved pipe clamp. Interested readers should refer to the National Electrical Code for the information it gives in regard to the grounding of secondaries. V. G. McDonald.

Determining Power Taken by a Machine.

The best method of determining the size of motor to be mounted on a machine tool is to arrange to drive the tool in question temporarily by belt with a test motor, and then measure the input of this temporary motor. If it is not possible to conveniently do this, reference can be made to the tables given in the different electrical handbooks which indicate average values of the power necessary to drive machine tools of different sorts. A very convenient rig for determining power inputs where all of the machinery in the shop is to be equipped with motors is suggested in Fig. 1. The motor shown is mounted on a truck that can be drawn to any position in the shop.

Where the power required by the machine tool is to be determined, the motor on the truck is drawn to a convenient position near the tool and a temporary belt drive arranged between the tool and the motor. Then the machine is subjected to its usual cycle of operations, and the power input to the motor is in the meantime measured. This power input can be most effectively measured by a graphic

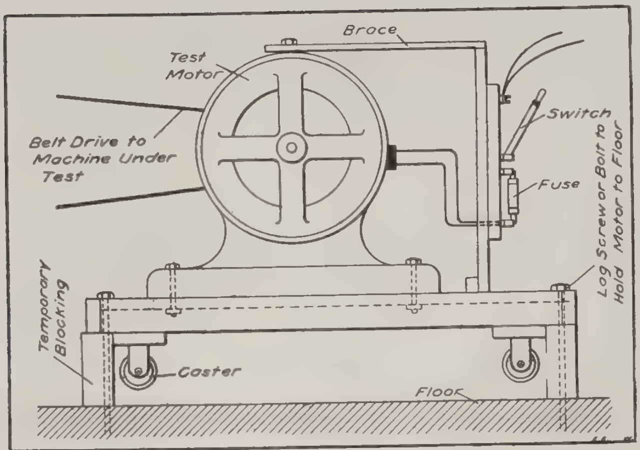


FIG. 1. PORTABLE MOTOR ARRANGED TO TEST POWER REQUIRED BY MACHINE TOOLS.

watt-meter, arranged as indicated in Fig. 2, which will show by a curve on a strip of paper the power taken by the tool at different instants of its operation. This curve constitutes a valuable permanent record, and provides information that is difficult to obtain in any other way. Where a curve drawing instrument is used it can be connected to the test motor in the morning and left there for a day or for several days, during which period it will be automatically making a record of the performance and the power taken by the tool.

If a graphic watt-meter is not available, the determination of power input to the motor can be made by taking simultaneous readings of an ammeter and a volt-meter. The watts, or power, at any instant for a direct current circuit will be the product of the volts and amperes at that instant. For an alternating current circuit the watt meter should be used. Connections for determining the power input with use of ammeter and voltmeter are shown in Fig. 3. Where it is necessary that the power input of a machine be determined very accurately, it is essential that the testing motor be calibrated, that is, its efficiency at different loads must be known. It may be possible to obtain an efficiency curve of the testing motor from its manufacturer, or if such is not obtainable, efficiency data for it can be determined by tests as outlined in handbooks and

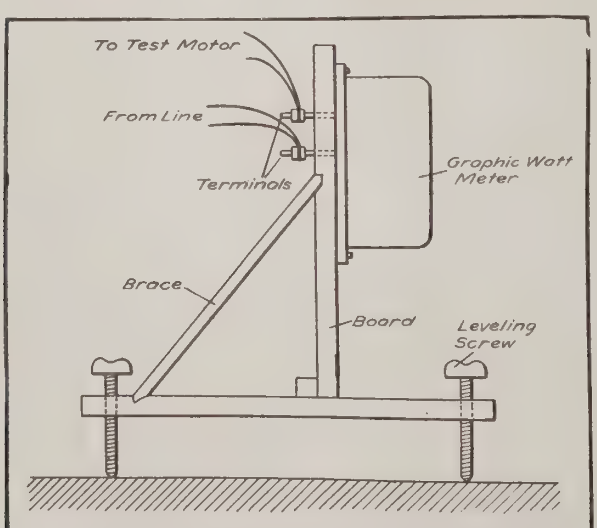


FIG. 2. GRAPHIC WATTMETER ARRANGED FOR TESTING POWER INPUT TO MACHINE TOOLS.

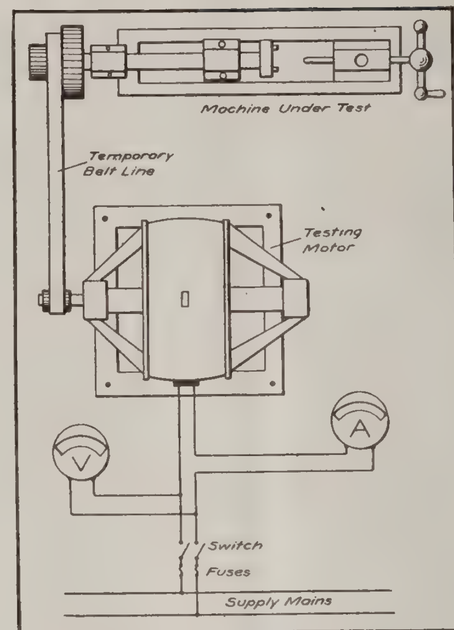


FIG. 3. CONNECTIONS OF APPARATUS FOR TESTING POWER INPUT TO MACHINE TOOLS.

text-books. The power output of a motor at any instant is equal to its power input at the same instant multiplied by the efficiency of the motor at the load it is carrying at that instant.

Frequently such refinements as corrections for efficiency as above outlined are considered unnecessary, inasmuch as the purchaser will necessarily have to buy a manufacturer's standard size motor as made by some manufacturer, and due to the fact that it is always desirable to have a motor at least large enough, corrections for efficiency may be an undesirable refinement.

Physicians' Use of the Electric Vehicle.

The Electric Vehicle Association is in receipt of a lettel from a physician in Kansas City—one of the hilliest cities in the country—extolling the virtues of the electric vehicle as used in his practice in the place of five horses for the past six years. He further states that he obtained 12,000 miles from his first set of batteries and the same mileage from his first set of tires. He also advises that the average cost of charging, which he does at home, is $7.50 a month, and that the repairs and upkeep averaged less than $5.00 a month for the six years he has had the vehicle, which is still running with entire satisfaction.

Ths doctor's experience is probably not much different from that of a large number of physicians all over the country, for the electric appeals especially to them on the basis of its low operating cost, its dependability and noiselessness, and particularly for its cleanliness, which is a most important factor to men of this profession.

Correction to Article of December Number.

On page 503 of the December issue appears two errors. The sentence beginning "The braces," ten lines from the bottom of column two should be changed to read, "The braces are 40 inches by 12 inches by 3/8 inch attached, etc.," the word feet being changed to inches. In the illustration, Fig. 3, the sag for the long span should be shown as 61 feet instead of 16 feet, as stated in the text of the first line of page 504, column one.—Editor.

Questions and Answers from Readers

Readers are invited to make liberal use of this department for discussing questions, obtaining information, opinions or experiences from other readers. Discussions and criticisms on answers to questions are solicited. However, editors are not responsible for correctness of statements of opinion or fact in discussions. All published answers and discussions are paid for.

Calculation of Line Loss with Fluctuating Load.

Editor Electrical Engineering:

(498) I would like to know how to arrive at the actual power or energy loss in a direct current line where the load fluctuates rapidly between zero and full load. Since the line loss due to resistance is (I^2R) or this loss varies as the square of the current, it would seem to the writer that even if the average current is known that such a value if used would not give the true loss. I have been unable to find anything on this subject in handbooks and would appreciate the opinion of readers as well as suggestions on calculation of the loss. C. A. H.

Trouble with Wattmeter Reading on Arc and Induction Motor Circuit

Editor Electrical Engineering:

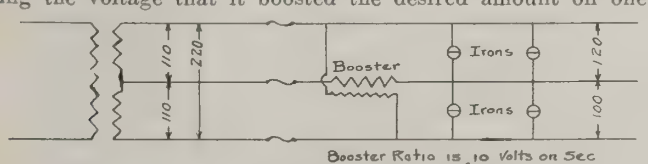
(499) On our three-phase circuit we have one three-phase, 50 horsepower 2200 volt induction motor and another three-phase, 30 horsepower 220 volt induction motor. We also operate a series street lighting system. The station integrating watthour meter is a polyphase Westinghouse design connected with potential and current transformers in the usual way. This meter will register and run in the proper direction only when both of the induction motors and street lighting circuits are in operation. When the 220 volt, 30 horsepower induction motor is in circuit and the street series lamps in operation with the 50 horsepower 2200 volt motor stopped, the meter runs in the wrong direction. When the 50 horsepower 2200 volt motor and the street series lamps are operated together without the 30 horsepower induction motor, the meter will not run at all, that is the discs will stand still. What is the cause of this and how can the trouble be remedied? V. K. S.

Peculiar Action of Booster.

Editor Electrical Engineering:

Please insert the following in the Question and Answer Department of *Electrical Engineering:*

Power for heating the irons in a laundry is supplied from a 3 wire 110-220 volt alternating current circuit. The drop on the line was so great that the heating of the irons was unsatisfactory. In order to remedy this it was decided to install a booster in the neutral, at the consumer's premises, to boost both sides of the 3 wire circuit. This was done, connections being made as shown in the sketch. Much to the surprise of all concerned it was found on testing the voltage that it boosted the desired amount on one side of the 3 wire, but subtracted a like amount from the other side. Why did it act in this way?



CIRCUIT CONNECTIONS FOR BOOSTER.

The booster was then cut into one of the outside lines, and worked satisfactory. C. E. B.

Number of Single Pole Lightning Arresters for 2200 Volt Service.

Editor Electrical Engineering:

We have a 50 horsepower 2200 volt, three phase induction motor direct connected to a centrifugal pump located three miles away. The line to this motor has installed on it 39 type C Westinghouse lightning arresters, that is 13 arresters to each line, the entire line being three miles. Is it necessary to have so many arresters for a line of this length? Also could there be any danger of a ground from so many arresters? V. K. S.

Some Transformer and Motor Problems.

Editor Electrical Engineering:

(502) The writer would like some information on the following subjects:

(1) If I have six single phase transformers connected in parallel as shown in Fig. 1, and any one or two transformers are damaged regardless of their position in the group, would it be possible to disconnect the damaged one or ones and continue operating the remaining transformers without changing the connections? Would the phase relations remain the same and what would be the capacity of each transformer in per cent of the capacity for normal connection when one and when two transformers are disconnected?

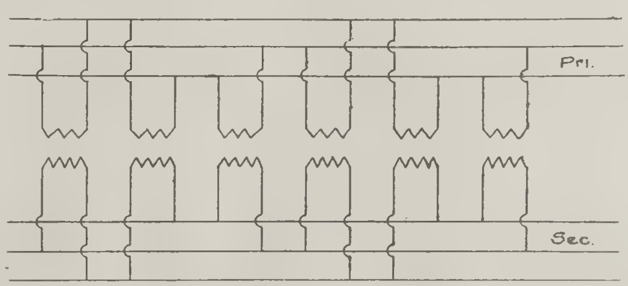


FIG. 1. CONNECTIONS FOR SIX SINGLE PHASE TRANSFORMERS.

(2) If a three-phase induction motor be rated at 2080 or 2200 volts and is being operated on from 2400 to 2500 volts with an ammeter in the circuit but no voltmeter and it is desired to know the load in Kw., would it be sufficiently correct to use the motor rating in figuring the load on the motor or should the actual applied voltage be used? In other words, how does the capacity of an induction motor vary with a variation of applied voltage? Does operating an induction motor on a higher voltage than its rating calls for, increase its torque or does it simply increase the excitation and losses with no increase in torque? T. C. M.

Discussion on Calculation of Flux of Magnets. Ans. Ques. No. 475.

Editor Electrical Engineer:

The answers given in the November issue for calculation of flux through a block of iron all fail to take account of one important limitation. Use is made of the formula H L $= 0.4 \pi$ n I where H is magnetizing force, L is length and n I is ampere turns. This formula only applies if the diameter of the coil is negligible with respect to its length. In the case assumed the diameter of the coil is nearly equal to its length so that the formula does not apply even approximately. It must be remembered in the calculation of flux that it is necessary to have a complete magnetic circuit. In this case a formula analogous to Ohm's Law holds, namely, $\phi = nI/R$ where ϕ is flux, nI is ampere turns, R is reluctance.

Field Coils Connected Ahead of Armature in Street Railway Motors. Ans. Ques. No. 482.

An explanation of connecting field coils ahead of the armature on railway motors is given in the November issue which is misleading. The statement is made that the fields are connected ahead of the armature in order to receive the current first and thus furnish the necessary flux. We know that no field will exist unless there is a complete circuit, but as soon as this is established, current flows equally in all parts of the motor since the field and armature are in series and all current going through one must go through the other. It is immaterial from a point of view of torque whether the field or armature is connected to the positive side of the line. This can be easily verified by experiment.

Two and Three-Phase Loads From Two-Phase Alternator With T. Connection.

If a two-phase alternator is connected in T, operation will be satisfactory on the three-phase line. The middle of one coil should be connected to a point 86.6 per cent from the end of the other coil. If this is done care must be taken that all other apparatus on the two-phase line has its phases insulated and not interconnected or else a short circuit will occur. Both two and three-phase loads may be taken off if the machine is not overloaded.

R. H. Willard.

Method of Calculating Cost of Power Generated by a Steam Plant. Ans. Ques. No. 484.

Editor Electrical Engineering:

A comparison sufficiently accurate to determine whether a steam plant should be continued in operation, or closed and electric energy purchased, can only be made from the most complete and carefully taken data and a study of the particular plant under consideration. Since it is the method that is asked for, however, rather than definite figures, the writer will indicate the method of figuring employed by himself in solving similar problems, assuming data wherever necessary. G. T. B. can then substitute for this assumed data, figures pertaining to his own plant. Table 1, for instance, is compiled wholly from assumed data as regards the plant under consideration. The writer has always used, in comparisons of this nature, the "flat rate" system of figuring depreciation. That is, assuming the useful life of a boiler to be twenty years and charging off annually 1/20th or 5 per cent of the first cost installed. There are many other and more complicated systems of figuring depreciation but their use seems a waste of time in view of the fact that a machine is often scrapped before it is physically unfit for use, due to obsolesence of design, radical changes in the demand on the plant, etc. Insurance will vary, depending upon the construction of the plant, risk, etc. Taxes will likewise vary, depending upon the location of the plant. Maintenance will vary depending on the type of apparatus, service, attention, etc. But G. T. B. can supply his own figures for all of these, including the first cost of the machinery in his own plant.

Now to get back to the problem. We strongly suspect that the data given is from an electric service plant running 24 hours per day with its resultant low load factor. If the data is from an ordinary factory plant, running 10 hours per day, 26 days per month, the average load would be 62700/260 = 241 kw., or greater than the maximum load of 230 Kw. as given. For an accurate analysis, we should have the station load curve, together with that for each unit.

For the purposes of illustrating the method employed, let us assume that this data is from an ordinary factory power plant, running 11 hours per day, 26 days or 286 hours per month. The average load is therefore, 62700/286 = 219 Kw. 219/275 = 79.6 per cent of the capacity of the plant. Assume that each generator carries its proportion of the load, *i.e.*, each carries 79.6 per cent of its rated capacity. Then the average load on the 200 Kw. generator $= 200 \times .796 = 159$ Kw. and that on the 75 Kw. machine $= 75 \times .796 = 60$ Kw.

For the 200 Kw. unit we will assume 93 per cent generator efficiency and 90 per cent engine efficiency. Then we have an average Ihp. of engine $= 159/(0.93 \times .746 \times .90) = 255$. If we assume a water rate of 30 pounds per Ihp. hour, we have a steam consumption of 7,650 pounds per hour for the large engine. For the 75 Kw. unit, assuming efficiency of generator = 90 per cent and that of engine = 87 per cent, we have Ihp. (average) $= 60/(0.90 \times 0.746 \times 0.87) = 102.5$. Assuming a water rate of 35 pounds per Ihp. hour, the steam consumption of the smaller engine $= 102.5 \times 35 = 3{,}590$ pounds per hour.

STEAM CONSUMPTION.

Large engine	7,650 pounds per hour.
Small engine	3,590 pounds per hour.
Feed pump	600 pounds per hour.
Total	11,840 pounds per hour.

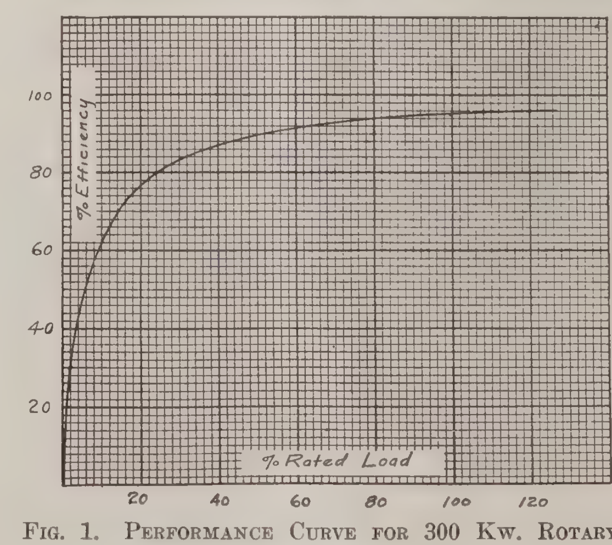


FIG. 1. PERFORMANCE CURVE FOR 300 KW. ROTARY CONVERTER.

The water rate of the feed pump is assumed at 150 pounds per water horsepower per hour, based on displacement of plungers.

EVAPORATION AND COAL CONSUMPTION.

Assume boiler pressure = 125 pounds per square inch gage and feed water temperature = 207 degrees Fahrenheit. Then the factor of evaporation (for method of figuring this we refer to any engineer's handbook, it requires steam tables), equals 1.049 and one boiler horsepower = 33.5/1.049 = 32.9 pounds water evaporated per hour under the above conditions of pressure and temperature. Wherefore the boiler horsepower developed = 11840/32.9 = 360. Let us assume that G. T. B.'s plant consists of three water tube boilers of 150 horsepower each.

In all of the above, G. T. B. should replace the assumed figures by actual values pertaining to his plant. First cost of machinery, its age, maintenance, rates of interest, insurance and taxes, etc., can be obtained from the books of the company. Engine and generator efficiencies and steam consumption or water rates of the former may be obtained from test. Evaporation and coal consumption figures should be taken from test or his own plant records, preferably the latter. If measuring instruments for feed water or steam, and indicators for the engines are lacking, he can base his figures on switchboard readings and coal burned.

ELECTRICAL PLANT.

Based on the assumptions already made as regards hours of operation and load factor, etc., I would recommend figuring on the installation of a 300 Kw. rotary converter. This size will allow for some growth in plant demand and will operate efficiently, due to the remarkably high efficiency of a rotary converter at reasonable underloads. Should the plant conditions be radically different than those assumed, the size of unit or units should be probably modified.

TABLE I.
FIXED CHARGES.

Steam Plant	No.	Size	Unit	Unit Cost	Total Cost	FIXED CHARGES—% Interest	Depreciation	Insurance Taxes	Maintenance	Total	Fxd Chgs. per year
Boilers	3	150	B. H. P.	$14.00	$6300	5	5	1½	6½	18	$1134
Engine	1	320	I. H. P.	11.00	3520	5	5	1	3	14	493
"	1	120	I. H. P.	10.00	1200	5	5	1	3	14	168
Generator	1	200	K. W.	12.50	2500	5	5	1	1	12	300
"	1	75	K. W.	13.35	1000	5	5	1	1	12	120
Building					9000	5	3	1	1	10	900
Feed Pump					200	5	7	1	3	16	32
Feed Water Heater		400	H. P.	1.50	600	5	5	1	3	14	84
Piping					2000	5	7	1	3	16	320
Total											$3551
Elec. Plant—Power Purchased											
Building					3000	5	3	1	1	10	300
Rotary Converter					2000	5	5	1	1	12	240
Total											$540

Assuming an actual evaporation of 7.0 pounds water per pound coal, the coal required = (11840 × 11) ÷ 7.0 = 18600 pounds per day of 11 hours, to which we will add 1,400 pounds for banking over night, making a total of 20,000 pounds, or 10 tons per day of 24 hours = 260 tons per month = 3,120 tons per year of 312 working days. For the remaining 53 days (Sundays and holidays), assume 2 tons per day, thus adding 106 tons and making the yearly consumption = 3,226 tons. Assume that coal costs $3.25 per ton delivered on the siding and adding 20 cents for unloading and handling done by other than the boiler room labor, we have the cost of coal for the year = 3,226 tons at $3.45 per ton = $11,118.

Table 1 shows the annual fixed charges on building and equipment. Assume oil and waste to cost $300 per year. Assume labor as follows:

1 Engineer	@ $1,500	per annum.
1 Assistant and fireman	@ 900	per annum.
1 Boiler room helper	@ 720	per annum.
Superintendence	@ 300	per annum.
Total	$3,420	per annum.

Table 3 shows the total cost of the steam plant to be $18,390 per year or 2.450 cents per Kw. hour based on 62,700 Kw. hours delivered per month.

TABLE II. COST OF POWER, ELECTRICAL PLANT AND PURCHASED POWER.

	Dollars per month.
Primary Charge:—	
10 Kw. @ $3.50	$ 35.00
40 Kw. @ 2.50	100.00
200 Kw. @ 2.00	400.00
Total Primary $535.00	
Secondary:—	
500 Kw-hr @ 4.50 cents	$ 22.50
4500 Kw-hr @ 2.50 "	112.50
45000 Kw-hr @ 1.00 "	450.00
18900 Kw-hr @ 0.90 "	170.10
Total Secondary $755.10	
Total	$1290.10
12 × 1290.10 = $15481 per year.	

TABLE III. FINAL COMPARISON, STEAM PLANT VS. PURCHASED POWER.

	Steam Plant $/Year	Steam Plant c./Kw. Hr.	Power Purchased $/Year	Power Purchased c./Kw. Hr.
Fixed Charges	$ 3551	0.473	540	0.072
Supplies	300	.040	150	.020
Labor	3420	.455	1500	.199
Fuel	11118	1.482		
Power			15481	2.059
Total	$18390	2.450	$17671	2.327

With a 300 Kw. rotary, the maximum demand of the plant, which is 230 Kw. will be 230/300 = 77 per cent of its rating and at this load the rotary's efficiency will be 92 per cent. At the average load of the plant, namely 219 Kw., the rotary will operate at 219/300 = 73 per cent rating with an efficiency of 91 per cent. The efficiency curve of this rotary is shown in Fig. 1. The customer must pay for the rotary's losses. Therefore the demand instead of 230 Kw., will now be 230/0.92 = 250 Kw. and the average load, instead of 219 Kw., 219/0.91 = 241 Kw. The Kw. hours per month, instead of 62,700, will be 62,700/0.91 =68,900. It is for these amounts that we must now pay. For monthly and yearly power bills, see table 2.

In case of the electrical plant, oil and waste is figuerd at $150 per year and labor is assumed as follows:

1 Operator at $1,320 per annum and superintendence at $180, making a total of $1,500 per annum.

Table 3 shows the total annual cost of the electrical plant to be $17,671 per year or 2.327 cents per Kw.-hour delivered. It will be noted that in reducing this cost to cents per Kw.-hour, we divide $17,671 by 12 × 62,700 and not by 12 × 68,900, since to compare with the steam plant, we must have the actual cost per Kw.-hour utilized in the

plant. Table 3 also shows the comparison between the two plants. This manner of arranging the comparison has the advantage of showing just wherein are to be effected the saving, if any. On the basis of the foregoing data and assumptions, the electrical plant appears to have the advantage by a very small margin.

There are several other points on which a great deal of stress should be laid, for any one of them would decidedly affect the comparison:

1. Steam Heating. If any of the exhaust steam is utilized for heating (other than feed water heating), due credit must be given the steam plant in the comparison, by giving it an annual credit equal to the total cost of running a separate heating plant. This should include fuel, labor and fixed charges on all the necessary equipment excepting radiators and piping of the heating system. If the exhaust steam is sufficient for only a part of the heating system, the steam power plant should receive credit for its share. In figuring such comparisons the writer usually figures up a separate heating plant complete, with its fixed charges, fuel and labor and adds the same to the cost of the electrical plant. He takes the stand that if you purchase electrical energy, you must provide a heating plant.

2. Transformers: No mention is made in the data given of transformers and we assume that they are either unnecessary or that their expense is to be borne by the central station. If such is not true, and we purchase power by meters located on the high tension side of the transformers, we must charge against the electrical plant the fixed charges and losses of the transformers and the wiring between them and the rotary, together with any additional building space occupied by them. It is assumed that the electrical distribution system in the plant is the same in both cases and does not enter into the comparison.

3. Night Attention: The question of night attention has not been considered, for the reason that it may be the same in both cases and therefore not enter into the comparison. That depends on the plant in question. If there is no night service required the steam plant may require a night fireman, or the night watchman may be able to look after it. This he can do for the electrical plant. In case he were able to look after either plant, it is highly probable, that the steam plant would require a greater proportion of his services than the electrical plant and should be charged accordingly.

T. B. Hyde.

Calculating Cost of Power as Generated by Steam. Ans. Ques. No. 484.

Editor Electrical Engineering:

In reference to question No. 484 in *Electrical Engineering* for October, 1914, it is unfortunate that G. T. B. did not include data relating to the daily operating period and the character of the service that the plant furnishes. The absence of information on these points necessitates unsatisfactory assumptions.

Owing to the values submitted for maximum demand and monthly energy consumption, it would be erroneous to assume a ten hour day service during 26 days per month, which is the customary working period in manufacturing industries, since on this basis the average hourly load would exceed the maximum demand. In order, however, to reach any conclusion it is necessary to decide upon a daily operating period, consequently it will be assumed that the plant in question operates continuously during 365 days per year. While this assumption may not represent actual conditions, it will at least afford a basis for demonstrating the method of computing the yearly cost of generating energy and comparing same with central station service which seems to be the chief object of the inquiry.

The first step in the calculations will be to find the boiler capacity to meet the peak load conditions, in order that fixed charges on these units may be properly accounted for. With a maximum demand of 230 kilowatts, the probable "water rate" of the large engine will be 40 pounds of steam per kilowatt hour, consequently the hourly steam consumption under these load conditions is 230 $\times$ 40, or 9,200 pounds plus 10 per cent for auxiliaries, pipe line losses, etc., or a total of 10,120 pounds per hour that the boilers must supply during maximum demand periods.

Assuming that the steam pressure is 130 pounds gage and that the temperature of the feed water entering boliers is 200 degrees, each pound of feed water must receive in the boilers 1024.8 heat units to convert into steam at the assumed pressure. Therefore, the boilers must be capable of furnishing 10,120 $\times$ 1,024.8, or 10,371,000 heat units per hour. Since a boiler horsepower is equivalent to 33,500 heat units, the boiler capacity required will be 10,371,000 $\div$ 33,500, or 310 horsepower. Three 150 horsepower water tube boilers will therefore be considered in estimating the installation costs.

The second step in the calculation will be to determine the yearly coal requirements. With a monthly consumption of 62,700 kilowatt hours, the average hourly load of 24 hour service will be 62,700 $\div$ 24 $\times$ 30, or 86 kilowatts approximately. To allow for load fluctuations on engines and boilers, it will be assumed that the water rate of the engines is 45 pounds of steam per kilowatt hour, and that the boilers evaporate 6 pounds of steam per pound of coal. This evaporation corresponds to 51 per cent boiler efficiency, assuming the heat value of the fuel to be 12,000.

On a basis of 8,760 hours per year, the total yearly steam requirements, including 10 per cent for auxiliaries, pipe line losses, etc., will therefore be 86 $\times$ 45 $\times$ 8,760 $\times$ 1.1, or 37,291,000 pounds, and since each pound of coal evaporates 6 pounds of steam, the coal necessary to evaporate this quantity of steam is 37,291,000 $\div$ 6 = 6,215,100 pounds, or 3,110 short tons.

Having determined the boiler capacity and the yearly coal requirements it is possible to approximate the yearly operating costs, as given in the following tabulation:

INSTALLATION COST.

1—120 H. P. 4-valve engine (erected)	$2,600	
1—320 H. P. 4-valve engine (erected)	5,800	
Foundations	750	
3—150 H. P. water tube boilers (erected) ..	7,500	
Steel stack foundation—breeching erected .	2,000	
Feed water heater—boiler feed and house pumps	1,000	
Piping—covering separators, tanks, etc ...	4,000	23,650
1—75 Kw. D. C. generator erected	1,100	
1—200 Kw. D. C. generator erected	3,000	
Switch board and wiring	1,700	5,800
Total cost of plant		29,450

GENERATING COST.

Interest on $29,450 @ 5%	$1,470	
Depreciation on 29,450 @ 6%	1,770	
Taxes, insurance, etc., on $29,450 @ 1% ..	295	3,535

Fuel, 3,110 tons @ $3.00	9,330	
Labor (5 operators)	4,600	
Ash hauling	100	
Oil waste, etc.	300	
Maintenance and repairs	600	14,930
Total yearly cost of generating 67,200 × 12		
= 752,400 Kw. hours		18,465
Cost per kilowatt hour in cents		2.46

COST OF CENTRAL STATION SERVICE.

Since the connected load is 275 kilowatts, the primary charge will be $2.00 per month and the average monthly energy consumption of 62,700 kilowatt hours will fall under the current charge of 0.9 cents per kilowatt hour.

If a rotary converter is installed, the customer will probably be required to pay the conversion losses, with a converter efficiency of 90 per cent, the monthly bill charged against the consumer will therefore be 62,700 ÷ 0.9 = 69,500 kilowatt hours.

The yearly cost of purchased power will therefore be about as follows:

INSTALLATION COSTS.

1—250 Kw. rotary converter	$3,000	
Switch board	1,700	
	$4,700	
Interest, depreciation, etc., @ 12% on $4,700		560
Primary charge—250 × 12 months × $2.00		6,600
Current charge—69.500 × 12 × $.009		7,500
Night and day attendant		1,700
Oil, waste, repairs, etc.		70
Total yearly cost of 69,500 × 12 or 834,000		
Kw. hours		$16,430
Cost per kilowatt hour in cents		1.97

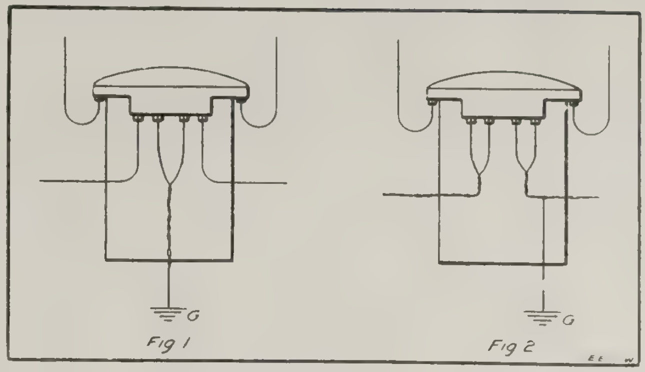
In the above estimates no consideration has been given the question of heating. Should the conditions demand this requirement, it will be necessary to make certain additional charges against the central station estimate in order to obtain a true comparison of power costs. These charges would consist of interest and depreciation on boiler capacity for heating, corresponding to the boiler capacity, available in the private plant for this purpose. Also a charge for fuel for generating steam, equivalent in amount to the exhaust steam from the engines of the private plant that could be utilized in the heating system. There would be a further charge for labor, maintenance, supplies, etc., in connection with the operation of boilers for heating.

H. Berkeley Hackett.

Connections for Grounding Transformer Secondaries. Ans. Ques. No. 487.

Editor Electrical Engineering:

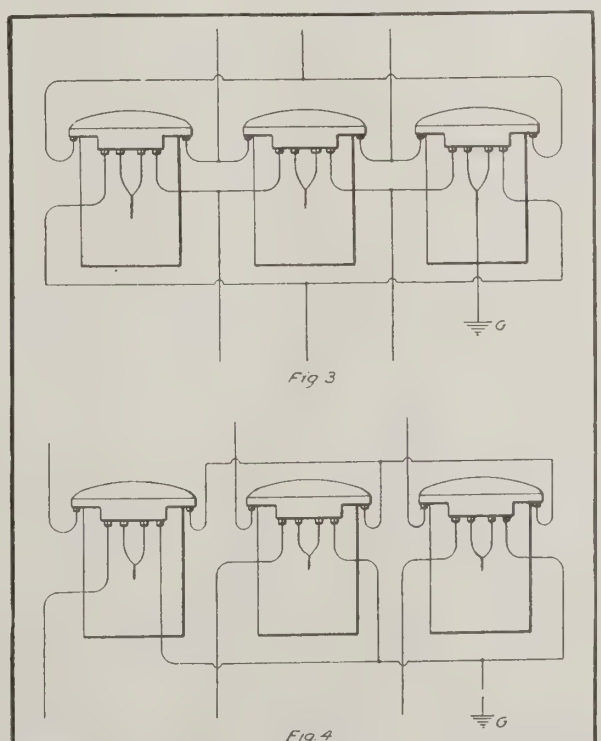
In answer to question No. 487, I give herewith the practice followed in the grounding of secondaries by a large light and power company of the Northwest. All transformers operating single phase three wire have their neutrals grounded, with connection as shown in Fig. 1. If the secondaries are connected in multiple, one side may be grounded as in Fig. 2.



FIGS. 1. AND 2. CONNECTIONS FOR GROUNDING SINGLE PHASE TRANSFORMERS.

In an interconnected polyphase bank, the neutral of any one of the transformers is grounded as in Fig. 3. In case the secondary leads are connected in multiple, and there is no neutral, ground any one common point. If the transformers in a polyphase bank are star connected ground the neutral as shown in Fig. 4.

Grounds are secured by driving not less than a 1½-inch galvanized pipe, 5 to 6 feet into the ground. The ground wire should be the same size as the line it is protecting and in no case less than No. 6 B. & S. It should be soldered securely to the ground pipe and lead straight up the pole, through a piece of ½-inch pipe or conduit for the first 8 or 10 feet, to protect it from injury where in reach of any person on the ground. The conduit must be nailed to the pole by sheet iron straps similar to pipe straps, home-made ones can be made from light galvanized iron.



FIGS. 3 AND 4. CONNECTIONS FOR GROUNDING 3-PHASE TRANSFORMER BANK.

From 1½ to 2 gallons of salt should be put around each ground pipe, and if installed in dry weather should be wet down. Cover ground pipe entirely over with soil to protect connection and the salt.

Chas. E. Beckwith.

ELECTRICAL ENGINEERING

DANIEL H. BRAYMER, Editor.

Devoted to the generation, transmission and distribution of electrical energy for lighting, heating, power and traction. Correspondence suitable for the pages of ELECTRICAL ENGINEERING is solicited and paid for. Name and address of correspondents must be given,—not necessarily for publication.

Published monthly by the W. R. C. SMITH PUBLISHING CO., at Dalton, Ga.; editorial and advertising departments, Grant Building, Atlanta, Ga. Entered as second-class matter at the postoffice at Dalton, Ga. Subscription rate $1.00 for two years; Canada $1.00 a year; foreign $1.50 a year.

Vol. 47. JANUARY, 1915. No. 1.

CONTENTS.

Forty per cent of the population of the United States use electricity in some way every day.

Five per cent of our population gets a living from and on account of electricity.

In 1877 the total investment in electrical industries was around $50,000,000. Today there is an investment of around $10,000,000,000.

The value of electrical goods produced each year in this country is about $300,000,000. The amount paid for electric service, apparatus and supplies per year by the public is $2,000,000,000.

There are 8,730,000 telephone stations in the United States, 65 per cent of the telephones in the world. Europe has four times the population of the United States and less than one-half the number of telephones.

France has fewer telephones than Chicago; Russia fewer than Philadelphia; while New York City has about twice as many telephones as Germany, Great Britain, Canada and France combined. In the Hudson Terminal Building, New York City, there are more telephones than in all Greece.

There are about 60,000 postoffices and 60,000 railroad stations in the United States with 70,000 places connected with telephones. Over the Bell system alone 27,000,000 messages are handled every day.

Southern Business Conditions.

Beginning with the month of August of the past year, the business men of this country began to take on a serious look. With a terrible war involving all Europe and raging without prospect of an early end; with a wheat embargo threatening great loss to the West and the export of a large cotton crop closed to the South; with deficits in bank reserves in New York and clearing house certificates being issued, there was just reason for consternation. However, a practical and satisfactory adjustment of all these conditions during the past four months has proven that the financial and commercial foundations of this country are sound. The wheat exports of the West are now unprecedented in amount and at favorable prices, cotton is moving with the exchanges of New York and New Orleans doing a regular and favorable business, the deficits in New York banks has been changed to a surplus reserve of more than half the former deficit, clearing house certificates are disappearing, emergency notes have been withdrawn and a great federal reserve system created and put into operation by the government supplying the banks of the country with sufficient loaning funds for all purposes.

With both money and crops in far better condition than could possibly have been expected only a few months ago and with both in many respects in good condition, the same is true of our industries. In the South the majority of cotton mills are running full time and many over time and the business conditions rather than being stagnated by the slow marketing of the cotton crop according to some of the reports circulated in northern circles, are equally as encouraging if not more encouraging than in other sections of the country. In confirmation of this statement, we quote from a statement made by Hon. John H. Fahey, president of the Chamber of Commerce of the United States, who with the directors of the chamber recently made a special trip through the South investigating financial and industrial conditions. Mr. Fahey says:

"It was suggested to us even after arrangements had been made for the Southern trip that we were going to the South at a most unfortunate time and that it might be better to postpone the journey. We are very pleased that we did not do so. The reports which have been circulated giving the impression that the South was nearly prostrated and in a state bordering on panic as a result of the shutting off of exports of cotton, lumber and naval stores have certainly been very much exaggerated. We have had opportunity to talk with hundreds of business men, many bankers, planters, merchants and commission men. While all recognize the fact that the disruption of business caused by the war brought problems out of the ordinary, we found everywhere the sentiment that time, patience, determination and energy would solve them.

"It must be remembered that the South, during the past few years has been enjoying the greatest prosperity in its history, and was better prepared than ever before to meet the present situation. The substantial evidence of this prosperity is reflected in the progress of every Southern city. *It would be an inspiration to business men in other parts of the country if they could go through the South today and observe its development.* The gain that has been made is surprising, and the plans for further growth made before the war broke out are going ahead just the same. Every port is making or planning extensions of its facilities with the money in hand for the work in most cases. The southern port cities are fully alive to the opportunities ahead as a result of the opening of the Panama Canal, and the growth of Central American trade. But more important still is the genial spirit of confidence in the future, and optimism which characterizes the Southern business men today.

"All of these elements are making for an evolution of the South during the next five years which cannot fail to be of the greatest importance to the nation, for there is a wealth of opportunity in this section which the country as a whole hardly understood or appreciates."

At the December meeting of the Electrical Supply Jobbers Association, the national organization of the electrical jobbing interests, held at Birmingham, Alabama, jobbers and manufacturers from all parts of the country expressed confidence in buying for the coming year. While there is a general uncertainty of the extent of such as in all other businesses at the present time and a hand-to-mouth buying expected for the immediate future, it is conservatively expected that there will be a return of normal demands within the next six months. The electrical apparatus and supply business for the past six months has been off about twenty-five per cent with, however, a decided pick-up during the months of November and December.

It has been said and we repeat it with added force, that pessimism is only justified when the foundations of government are being undermined and the safeguards of the constitution being overturned and disregarded, a condition that cannot truly exist in this country as long as our business men stand on guard. Likewise optimism is only justified when it is based upon national progress born of unity of purpose and confidence in the integrity of all factors making up our national life and this we are happy to state is the condition toward which the financial, commercial and industrial interests of this country are rapidly tending even in the face of wholesale destruction of lives and property at present going on among the countries of Europe.

1914 Developments.

It is our custom to record in the first issue of these columns each new year, the important and noteworthy tendencies in the manufacture of electrical equipment and the progress in its application together with the trend of engineering as shown by the milestones of electrical construction that will go to the credit of the twelve months just passed. It is important to note that we now have to deal with developments in an industry in which ten billions of dollars are invested and serving practically every nook and corner of this country with light, power, railway and telephone service. According to a good authority, there was invested in the electrical industry in the early eighties not more than fifty million dollars and this amount largely in connection with telegraphic equipment and lines. The electric light and power business was then about to be born. Twenty years later this industry had grown to what was then considered a respectable revenue producing stage, the income from the existing central station companies furnishing light and power being eighty-five millions of dollars. In this year of our Lord 1915 the income of our 5,000 central generating plants is around 500 million dollars with the growth of the business over the period of the past twenty-five years such that the average rate of increase in income is 25 per cent, a record for the expansion of any known business if the automobile business is excepted.

In the South alone during the past two years some 64 plants have been completed or are under construction with a present capacity of one and a quarter million horsepower and an ultimate capacity of twice that amount. There are 36 other plants planned with another million horsepower capacity. The majority of these plants are of the hydro-electric type and assuming an average cost of $100 per horsepower, the capital represented is about 225 millions of dollars for this section, a conservative estimate we believe for the money that will be in actual operation before another series of twelve months rolls around.

There are ten hydro-electric systems in the South with a plant capacity of over 500,000 horsepower, operating more than 3,000 miles of main transmission line and selling to cotton mills alone nearly 2/5 of the above capacity, the remainder serving street lighting and street railway systems and the light and power demands of the various other industries of the South. During the past year, the main sub-stations of the Georgia Railway and Power Company and the transmission lines connecting same have been completed and placed in operation. The Lock 12 development of the Alabama Power Company has been completed and is now furnishing power to a large sub-station at Birmingham, Ala., which has also been completed during the year. A steam plant at Gadsden, Ala., and substations at this point and at Anniston, Ala., were completed and placed in operation last year. While water was turned into the penstocks of the second hydro-electric development on the Ocoee River in Tennessee by the Tennessee Power Company during October of 1913, the station was not fully completed until the early part of last year. The Sequatchie Valley transmission line has been completed during the year connecting the stations of the Tennessee Power Company with the hydro-electric plant of the Chattanooga and Tennessee River Power Company and the steam station at Nashville, Tenn. This line was fully completed during the past month although a part of it has been in operation since last August. Through this arrangement the Tennessee Power Company takes power from the Chattanooga and Tennessee River Power Company and has connected the cities of Chattanooga, Knoxville and Nashville by one of the longest transmission lines of the country.

The Southern Power Company is about to complete another water power station on the Catawba River and proposes to construct another auxiliary steam plant of 10,000 horsepower at Durham, N. C. In South Carolina a new company has been organized to be known as the Carolina Central Electric Company and has acquired and consoli-

dated central station distributing companies in the cities of Florence, Marion, Mullins and Darlington. It is understood that the consolidation of these plants will be under the control of the interests controlling the great Rockinham water power on the Yadkin River and that the movement may have some relation to the early electrification of the railroads of this section as well as the extension of electric power for manufacturing purposes throughout the eastern Carolinas.

During the early part of this year, the opening of a 31,000 horsepower plant on the Savannah River was celebrated and a short time later the starting of another plant known as the Parr Shoals development 27½ miles above Columbia, S. C. The former plant was constructed by the Georgia-Carolina Power Company and furnishes power to the Augusta-Aiken & Electric Corporation. The latter plant is of 29,000 horsepower and was built by the Parr Shoals Power Company, furnishing power to the Columbia Railway, Gas & Electric Co.

During the early part of last month an appeal was made to the rivers and harbors committee of congress to incorporate an appropriation for the locking and damming of the Tennessee River so as to overcome the **Mussel Shoals** obstructions to navigation. The company organized to construct this development is known as the Mussel Shoals Hydro-Electric Power Company and proposes to cooperate with the government by constructing two dams on the Tennessee River in the northern part of Alabama near the line between Alabama and Tennessee. According to plans made known there is a possibility of developing at this point 680,000 horsepower, the greatest hydro-electric project of its kind in the country. Such is a brief summary of the construction in the South which is going to the credit of the past year and the prospects for new work to be taken up during 1915.

Electrical Manufacturers Meet At New York and Discuss a Proposed New System of Wiring.

During the early part of December it was made known that the committee on wiring of existing buildings of the National Electric Light Association had approved and intended to secure the approval of the electrical committee of the National Fire Protection Association at its meeting in March of this year, on the use of a so-called concentric method of wiring. This system is said to make possible a reduction in the cost of wiring and enable central stations to secure a large number of possible small lighting customers who now consider the cost of wiring prohibitive, and in other ways promote the use of current consuming devices.

The manufacturers of standard wiring devices and fittings seem to believe that the approval and general adoption of the system as proposed will seriously affect the present nature of their business, and in order to discuss the matter in all its details, called a meeting at the Biltmore Hotel in New York City December 22. At this meeting some 150 representatives of manufacturers, electrical jobbers and others interested in the matter were present. The proposition was thoroughly gone into with the result that a committee was appointed to investigate the proposed system and report at another meeting, to be held Feb. 9. This committee will confer with the committee of the National Fire Protection Association and endeavor to secure a postponement of immediate action. Since this association has a reputation of going carefully and deliberately into all matters of a radical nature, it is confidently expected that the merits and drawbacks of the system will be given due consideration so that when its approval is finally given it will be on a system that will be satisfactory to all branches of the industry.

In brief the concentric system of wiring embraces the use of a copper core, rubber-covered wire encased in a tube of copper, the encasing tube being bare and used as a return conductor and is similar to systems used in England and Germany. It is proposed to use the wire in connection with grounded circuits and on branch circuits carrying 660 watts, running it in sight across ceilings and along walls and fastening by metal clips. Its use would then practically call for all switches of single pole design, no insulating joints and the omitting of fuses in neutrals. It would eliminate conduit and all sockets, and fixtures would be at earth potential.

The committee having the matter in charge is made up of the following, with Chas. L. Eidlitz, Metropolitan Electric Mfg. Co., N. Y., chairman.

Representating the wire manufacturers, Messrs. W. A. Connor, of the Standard Underground Cable Company, Perth Amboy, N. J., R. K. Sheppard, of the B. F. Goodrich Company, Akron, Ohio, and George A. Cragin, of the American Steel & Wire Company, Worcester, Mass.

Representing the conduit manufacturers, Messrs. C. E. Corrigan, of the National Metal Moulding Company, Pittsburgh, Pa., F. C. Hodkinson, of the Safety-Armorite Conduit Company, Pittsburgh, and L. J. Campbell, of the Western Conduit Company, Youngstown, Ohio.

Representing fitting manufacturers, Mr. H. B. Crouse, of the Crouse-Hinds Company, Syracuse, N. Y., W. T. Pringle, of the Pringle Electric Manufacturing Company, Philadelphia, and A. W. Berresford, of the Cutler-Hammer Company, Milwaukee, Wis.

Representing porcelain manufacturers, Mr. Herbert Sinclair, of the Star Porcelain Company, Trenton, N. J., and J. E. Way, of R. Thomas Sons Company, New York City.

Representing the jobbers, Mr. Frank S. Price, of the Pettingell-Andrews Company, Boston, E. W. Rockafellow, of the Western Electric Company, New York, and W. W. Low, of the Electric Appliance Company, Chicago.

Representing the electrical contractors, Mr. Ernest Freeman, of the Freeman-Sweet Company, Chicago, Mr. John R. Galloway, of Washington, D. C., and John Livingstone, of the J. Livingstone Company, New York City.

Representing electrical engineers, Mr. Gano Dunn, of J. G. White & Company, New York City.

Representing fixture manufacturers, Mr. Louis McCarthy, of the Macallen Company, Boston, Mass., and R. B. Benjamin, of the Benjamin Electric Manufacturing Company, Chicago.

Representing manufacturers of conduit boxes, Mr. R. B. Corey, of the Pratt-Chuck Company, New York City.

Representing socket manufacturers, Mr. W. C. Bryant, of the Bryant Electric Company, Bridgeport, Conn.

Representing fuse manufacturers, Mr. E. B. Hatch, of the Johns-Pratt Company, Hartford, Conn., Mr. L. W. Downes, of the D. &. W. Fuse Company, Providence, and Bryson S. Horton ,of the Detroit Fuse & Manufacturing Company, Detroit, Mich.

New Business Methods and Results

Representing Interests of Central Stations, Electrical Jobbers, Dealers and Contractors.

Thomas W. Peters Commercial Agent Columbus Railroad Co., Columbus, Ga., Outlines a Recent House Wiring Campaign.

A house wiring campaign which is of interest because of its results and the way it worked out, was a feature of the new business activity of the Columbus Railroad Company of Columbus, Ga., during the month of November, 1914. The scheme while planned to secure new customers had a secondary result in that it showed the employes of the commercial department and local contractors how much actual business they had missed in the past and created an enthusiasm which is certain to produce more house wiring business in the future. In commenting on the success of the campaign, Mr. Thomas W. Peters, commercial agent of the company, has the following to say:

"The success of this campaign can be readily seen from the fact that we secured 143 new electrical customers besides the sale of a good many appliances during the month. This campaign also included the general campaign for the securing of gas business. We believe we were very successful in this line also as we sold a good many extra gas appliances and secured 59 gas customers. We used considerable newspaper space in this campaign, a feature of which was the printing of the "ads" in a morning paper in red ink in place of the usual black ink.

"Each of the electrical contractors in town loaned us a man during the month and one of them went so far as to use his automobile in soliciting business. Every Saturday night the Commercial Department gave a supper to its members and one or two invited guests, at which time the prizes for that week were distributed.

"Taken all in all and considering the time of the year as well as conditions under which we had to operate, I believe this campaign was a "howling" success."

The prizes referred to by Mr. Peters were as follows: The securing of 200 points or more per week by any solicitor, $2.50 in gold; the securing of the highest number of points per week another $2.50 in gold and the securing of the highest number of points during the campaign, $5.00 in gold. The schedule of points based upon the nature of the contract secured was as follows:

Electric Contracts for Old Houses Wired	5 points
Electric Contracts for New Houses Wired	4 points
Electric Contracts for Old Houses Reconnected....	3 points
Sale of each Heating Device	1 point
Every Contract of $25 yearly revenue on Flat rate	5 points
Every 200 Watts Additional Load on Present Meter	1 point
Sale New Gas Stoves in Old Houses	5 points
Sale of Old Gas Stove in Old House (Reconnect)	4 points
Sale of Gas Heaters and Misc. Heaters (Additional)	2 points
Sale Gas Auto Water Heaters	5 points

The schedule of wiring prices for the campaign was as follows:

No. Lights and Switches	Stores	Residences
2 Lights	$5.00	......
3 Lights	7.00	$ 7.50
4 Lights	8.50	9.00
5 Lights	....	11.50
6 Lights	....	14.00
7 Lights	....	16.50
8 Lights	....	19.00
9 Lights	....	21.00
10 Lights	....	22.50
Snap Switches, Extra	1.75	1.75
Flush Switches	....	3.00

For a two-story residence, the rates per light for the first floor were twice the rates given above with the regular rates as given applying to any lights on the second floor.

The terms were 10 per cent off for cash with order in the case of either store or residence contract, or installment rates of $2.00 down and $1.50 per month for stores, and ¼ down when the current was turned on and balance in four monthly payments for residences.

Ross B. Maters, Commercial Agent Southern Sierras Power Company, Comments on "Too Much Red Tape."

Rules should be guides—sign posts, as it were, along the path of business, and should never be regarded as inflexible. A narrow view of such routine is what gives rise to the general term "red tape," which throttles the healthy growth of utility and employe, saps individuality and frequently makes the intelligent worker discontented. The exercise of originality, the development of individuality, and a recognition of the right of every individual to think, is bound to result in a development of employes best suited to promote the welfare of any organization.

The efficiency of many a central station organization is often hampered by too much of the above mentioned "red tape." Officials and department heads are appointed, charged with a great deal of responsibility and supposedly with authority sufficient to cover many situations that arise effecting the relations of the public and the company. Then certain rules are laid down for the guidance of the local executive. Routine is established and diligently does this "would-be" official endeavor to comply with the many instructions issued from time to time from a general office. Frequently such "trails" are so hedged in that the exercise of individual originality or judgment—which best governs local conditions— are thwarted regardless of the welfare of the utility. Rules that apparently seem inflexible chafe the individual who strives to look at them, not alone on one side, that of the public utility, but who is broad minded and views both sides of the proposition, in order to arrive at a happy medium such as will cement friendship between consumer and central station, instead of arousing in the mind of the public an antagonistic feeling. Make sure that your department heads are capable—then give them a free hand in the conduct of their work commensurate with the responsibility and results expected.

Concerning the Electrical Trade

News of Activity by Manufacturers, Jobbers, Dealers, Contractors and Engineers.

William Farr, President Piedmont Electric Company, Builds Up Large Wholesale Electrical Supply Business in Asheville, N. C., and Holds Record As Oldest Southern Electrical Supplier.

Eighteen years ago there were persons who smiled incredulously when William Farr confided in them that he planned to establish in Asheville, N. C., a large wholesale electrical supply business. In this year of our Lord, 1915, some of the self-same incredulous smilers are stockholders in the business institution of which William Farr is the guiding head.

William Farr was born in Brooklyn, N. Y. thirty-nine years ago and received his technical education at the Pratt institute of that city completing a course in mechanical engineering some time after entering practical work His first work in the electrical field was with H. E.

WILLIAM FARR, PRESIDENT PIEDMONT ELECTRIC COMPANY, ASHEVILLE, N. C.

and C. E. Baxter Company, of Brooklyn, manufacturers of electrical house goods such as bells, annunciators, etc. This was about 1890. Later he secured a position with James W. Queen Company, of Philadelphia, Pa., manufacturers of electrical instruments. He left this position to take one in his home city with the Hall Electric Signal Company, well known manufacturers of railway block signal systems. A position in the electrical equipment of the Brooklyn Navy Yard next attracted Mr. Farr, and while there he worked on the installation of electrical equipment in the Cruiser Cincinnati and the battleship Maine. Mr. Farr left this work to come to Asheville.

The beginning of Mr. Farr's work in the South was the organization of the firm of McKay and Farr, in 1896, to carry on a general contracting business in connection with all kinds of electrical construction. He was successful in this work from the start and in 1902 separated himself from the above firm and organized the Piedmont Electric Company, planning to divide his attention between the electrical jobbing business in the South and general contracting. He was again successful in these plans. As an indication of the degree of success, we may state that the Piedmont Electric Company has done work in various Southern cities, securing such contracts by competitive bids with some of the largest electrical contracting companies in the business. Among these contracts was the conduit and wiring system for the new Postoffice at Atlanta, Ga., and the wiring and lighting of the Grove Park Inn at Asheville, N. C., said to be one of the finest tourist hotel buildings of its kind in this country. All conduit and wiring in this building is placed in chases in the great stone walls of the structure. The entire lighting system is indirect.

About a year ago Mr. Farr decided, on account of the extent of the company's jobbing business which had grown to a point that it demanded a majority of his time, that he would discontinue all construction work and confine his efforts to the sale of electrical supplies among electrical dealers, central stations and the industrial plants of the South. Again his plans have been successful and the company has just completed the construction of a two story warehouse at the rear of its present show room and office, in order to enable the carrying of stocks sufficient to handle the demands of the trade.

The lines carried by the Piedmont Electric Company include all supplies required for lighting, power, and telephone service as well as a complete line of electric automobile accessories, which line has been recently added. The following is a list of the lines carried and the manufacturers represented. The force employed consists of eighteen people, with traveling men covering the Piedmont section of North and South Carolina, Georgia and Tennessee. A general supply catalog is issued as well as a telephone and fixture catalog.

Weatherproof Wire and Cable:
- Phillips Insulated Wire Co., Pawtucket, R. I.

Magnet Wire and Lamp Cord:
- American Electric Works, Phillipsdale, R. I.

Wiring Devices and Schedule Materials:
- Arrow Electric Co., Hartford, Conn.

Pole Line Material and Hardware:
- Hubbard and Company, Pittsburgh, Pa.

Switches and Panel Boards:
- Trumbull Electric Mfg. Co., Plainville, Conn.

Fuses and Cutouts:
- Detroit Fuse and Mfg. Co., Detroit, Mich.

Transformers and Meters:
- Duncan Electric Mfg. Co., Lafayette, Indiana.

Electrical Instruments:
- Norton Electric Mfg. Co., Manchester, Conn.

Heating and Cooking Devices:
- Simplex Electric Heating Co., Cambridge, Mass.
- Hotpoint Electric Mfg. Co., Ontario, Calif.

Incandescent Lamps:
- Banner Electric Division National Lamp Works G. E. Co., Youngstown, Ohio.

Batteries and Flashlights:
American Ever Ready Works, New York City.
Vibrators and Medical Apparatus:
Shelton Electric Co., New York City.
Electric Automobile Accessories:
Adams Bagnell Co., Cleveland, Ohio.

It is to be noted from the data given above that Mr. Farr heads the oldest southern electrical supply house continuously in business in the South between the cities of Richmond and New Orleans. The Electric Supply Company of New Orleans holds close second in point of age. Up to the time of its failure the Carter and Gillespie Company, of Atlanta, Ga., held the age record for the South, being established in 1891.

Birmingham (Ala.) Meeting of Electrical Supply Jobbers' Association—The First in the South.

From the appreciative remarks of the 200 electrical jobbers and manufacturers who assembled at Birmingham, Alabama, December 8 to 10 to attend the first meeting of the Electrical Supply Jobbers Association held in the South, it is inferred first that they considered the time and money demanded by the trip South well spent and second they were convinced that the South deserved this if not more frequent meetings. Oscar C. Turner, president of the Turner Electric Supply Company of Birmingham was alone responsible for bringing the meeting to Birmingham and this fact was voiced in various ways by the officials of the association. The way in which this individual enlisted the cooperation of all Birmingham in showing the jobbers a cordial welcome and special attention as regards entertainment, was nothing short of remarkable.

The association headquarters were at the new Tutwiler Hotel and the first session called to order Tuesday morning by Frank Overbagh, general secretary of the association. He introduced Judge J. O. Lane of the city commission of Birmingham who welcomed the delegates on behalf of the city. Paschal G. Shook, president of the Birmingham Chamber of Commerce, then welcomed the jobbers on behalf of the civic organizations. A response to this greeting was made by T. M. Debevoise, counsel for the association or the "hired-man" for Colonel Overbagh as he calls himself. Judge Debevoise said in part:

"Gentlemen, we have seen a true Southern welcome by representatives of this city who represent Southern hospitality, one of the nation's greatest assets. Oscar Turner brought this convention to Birmingham single handed. This shows how Mr. Turner stands with the association. We are glad to be here and that Oscar Turner put it over us." it over us."

The sessions held on Tuesday afternoon and Wednesday and Thursday mornings were closed to all except members. Matters of routine business and the conditions of the jobbing trade in general were discussed. Representatives from various parts of the country seemed to be in an optimistic mood when commenting on the business outlook, yet expect that a hand-to-mouth buying will prevail for the present until conditions become more settled in all other lines. The business for the past year has been off about 25 per cent as estimated up to November 1st. During the month of November business picked up somewhat and at the time of the meeting with the buying for the month of December yet uncertain, conditions generally looked favorable to a gradual revival of normal demands.

The entertainment of the jobbers was participated in by the city of Birmingham through its officials and Chamber of Commerce, the Press Club, The Birmingham Railway, Light and Power Company and the Alabama Power Company. The last named company furnished an attractive program of 24 pages containing besides the schedule for the meetings an illustrated description of the company's hydro-electric system and views of the industries it serves.

The entertainment included a cabaret and smoker at the Press Club on Tuesday evening. Oscar Turner presided as toastmaster and called on a number of jobbers for "smile-creating" remarks. On Wednesday a regulation barbecue was given at the Roebuck Golf and Automobile Club and in the evening a reception was held at the Country Club.

DELEGATES AND GUESTS AT OPENING SESSION OF ELECTRICAL SUPPLY JOBBERS' ASSOCIATION AT BIRMINGHAM, ALABAMA, DECEMBER 8 TO 10.

The residential sections of Birmingham were also visited by automobile on Wednesday and a good idea obtained of the Pittsburgh of the South. Thursday afternoon was given over to a trip through the industrial districts of Birmingham visiting the steel plants, a courtesy of the Tennessee Coal, Iron and Railroad Company. In addition to these as main features, there were several side trips, card and theatre parties for the visiting ladies. Golf and tennis enthusiasts were on hand and tournaments held Wednesday and Thursday mornings.

The next meeting of the Association was set for March, 1915, and to be held in Chicago.

Fire At the Edison Works.

On Dec. 9, a fire destroyed three of the 34 buildings of the Thomas A. Edison works at West Orange, N. J. The damage was estimated at about $1,000,000. Fortunately the fire did not get to Mr. Edison's office and experimental rooms, however, for fear of great loss here, the contents were removed as soon as the fire was discovered. This material could not have been replaced and was invaluable as historic records. Special plans for the safekeeping of these records are now being considered.

Work was at once started on reconstruction and it is said that the fire has had little effect on the various lines of the Edison business, even in those buildings damaged by fire, as engineering plans were at once put into effect so as to receive and fill orders as usual.

Gas-Filled Lamps for New York Street Lighting.

Experiments are proceeding in New York City with 500 nitrogen-filled lamps. These have been installed on Broadway between Forty-fifth and Seventy-second Streets, on Seventh Avenue between Forty-fifth and Fifty-ninth Streets and north of 110th Street, on Madison Avenue, between Forty-sixth and Fifty-fourth Streets, and on Fifty-fourth Street between Fifth and Sixth Avenues.

Their substitution for arc lamps throughout the city would save, it has been estimated, $400,000 per year.

Annual Meeting of the Atlanta Chapter of the Engineering Association of the South.

The Atlanta Chapter of the Engineering Association of the South, held its annual meeting Thursday night, Dec. 17, at the association's headquarters. At the close of the business session, the following officers were elected: L. W. Hatcher, president; R. M. Walker, first vice-president; A. P. McClellan, second vice-president; Lodowick J. Hill, Jr., secretary and treasurer. All of these gentlemen are prominent in local engineering circles, and most of them intimately have been connected with the affairs of the association for a number of years.

This association is a member of the affiliated Technical Societies of the City of Atlanta, which body has about 250 supporters as members of the branches of the national organizations of the city.

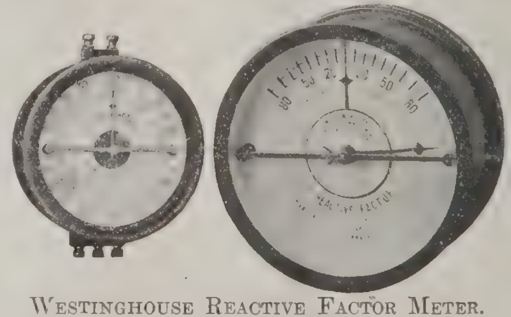
New Apparatus and Appliances

Reactive Factor Meters.

Computation and tests show that a power factor of even only one or two per cent less than unity is not as good as it appears to many station attendants, especially on rotary converters. At 98½ per cent power factor the armature copper loss in the leading tap coils of a rotary is almost half again as much as at 100 per cent power factor. Under heavy load this is often enough to cause trouble in the tap coils. Also, the average heating in all the armature coils is about a quarter again as much as 98½ per cent power factor as at 100 per cent. The capacity of the rotary is therefore decreased considerably.

The measurements of "idle currents" is in general a recent development, wattmeters having been used recently so connected as to measure the idle volt-ampere, or "wattless component." The reactive factor meter, a device recently designed by the Westinghouse Electric and Manufacturing Co., corresponds in its action to the power factor meter and bears the same relation to the latter, that the "wattless component meter" bears to the wattmeter. This meter indicates the sine of the angle of lag or load instead of the cosine as in the power factor meter. Unity power factor is, therefore, indicated as zero reactive factor. If instead of the power factor meter there is on the circuit a reactive factor meter, a condition of 98½ per cent power factor is indicated as 17½ per cent reactive factor, and the attendant will be more on the alert and will be more apt to improve it. Power factor and reactive factor are equal at the value 70.7 per cent. At higher power factor, the load conditions are more conspicuously indicated on the reactive factor scale. At lower power factors the reverse is true. Reactive factor meters are therefore recommended for use only on circuits operating normally at power factors close to unity and which never fall below 70 per cent.

The Westinghouse reactive factor meter operates on the rotating field principle like their power factor meters. A rotating field is produced in angularly placed coils connected in shunt with the metered circuits, one for each phase of the system in the case of polyphase meters



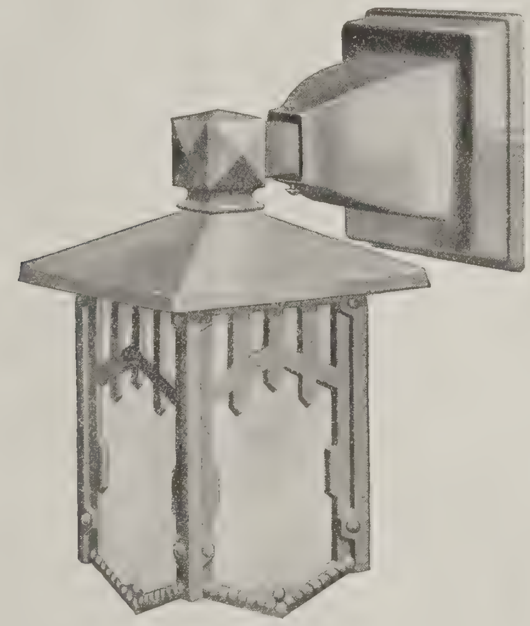
Westinghouse Reactive Factor Meter.

In their field is provided a movable iron vane or armature, magnetized by a stationary coil whose current is proportional and in phase with that of the line current in one phase of the circuit. As the iron vane is attracted or repelled by the rotating field of the angularly placed coils, it takes up a position where the zero of the rotating field occurs at the same instant as zero of its own field. Thus its position indicates the single phase angle between the voltage and current of the circuit. The reactive factor meter is then

calibrated to read the sine of the angle indicated while the power factor meter is calibrated to read the cosine. In the three-phase meter the rotating field is produced by three coils spaced 60 degrees apart; in the two-phase meter by two coils spaced 90 degrees; in the single phase meter the rotating field is produced by means of a split-phase winding connected to the voltage circuit.

Herwig Lamp Bracket.

The accompanying illustration shows a design of cast metal outdoor lighting fixture made by the Herwig Art Shade & Lamp Co., 2140 North Halsted Street, Chicago. This lamp bracket is known as No. 202 and embodies the patented unit construction feature familiar in all the products of this company. This feature allows the parts to be readily interchanged. This lamp bracket is subjected to the company's multi-coated process, made from a special formula. This process, it is claimed, provides the bracket with unusual wearing qualities, even when subjected to the most trying climate.



The Herwig No. 202 Lamp Bracket.

The maker assures the trade that his method of construction allows of quick and easy wiring. All openings are fitted with ⅜-inch nipples, which does away with the need of insulating joints. When finishes are not specified, dull black will be furnished with moss glass. Mottled green finish will be furnished only when specified with amber glass. The standard glass colors adopted by this company are amber, green, moss, and ground.

Western Electric Year Book.

The Western Electric Company starts the new year by distributing the first edition of its 1915 Electrical Supply Year Book. This catalog, for such it is, represents something radically new in the electrical supply field. No jobber is issuing a catalog more frequently than once every three years. It has remained for the Western Electric Company to adopt a definite policy of an annual catalog which it believes will serve to give the industry at all times the most information obtainable on the materials which it uses.

The book departs from the beaten path in another particular—in place of the manufacturers' list prices which catalogs of this kind have heretofore invariably carried, this new book announces a complete series of Western Electric list prices upon which a uniform basic discount applies, such a discount indicating to the holder of the catalog his approximate price on all the articles listed. It is significant that at last someone in the electrical field has had the far-sightedness to initiate, and the ability to carry out a comprehensive plan of readjusting the present confused price situation in the electrical field.

Transmission Line Calculator.

In the November, 1911, issue of *Electrical Engineering* appeared a description of an alternating current transmission line calculator designed for the rapid calculation of voltage drop in alternating current circuits. This device has now been enlarged so as to cover the whole field of transmission and distribution at moderate voltages and is being put upon the market as the "Engineer's Edition" of the Transmission Line Calculator by Robert W. Adams, 181 Taber Ave., Providence, Rhode Island.

In its new form the calculator consists of a three fold morocco leather volume 8¼ inches square, containing separate diagrams for 60 and 25 cycle work, each diagram being laid out for four different spacings of conductor, and each being equipped with a revolving transparent disc. The diagrams have been doubled in diameter over the first edition, so that the various scales are more open and therefore easily read, while at the same time they have been expanded so as to include a much wider variety of operating conditions.

For transmission at ordinary voltages there are provided quadrants for 18, 36 and 60 inch spacing of conductors, which will be found to cover most of the problems presented to the average designing or operating engineer. It is possible, however, by means of the frequency conversion chart to make accurate determinations for any spacing whatever up to 100 inches, and also for any frequency up to 100 cycles per second. For the benefit of those engaged in mill work quadrants have also been included for 6 inch spacing, and with this same work in mind the circular

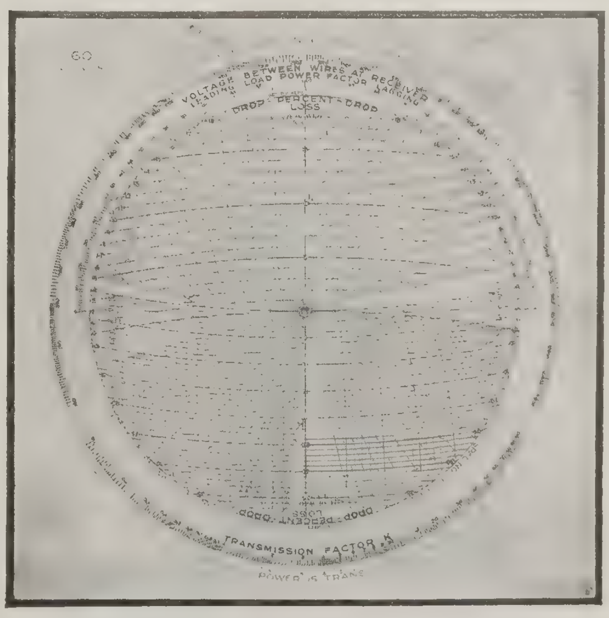


Fig. 1. 60 Cycle Diagram of Transmission Line Calculator.

scales have been greatly extended so as to include loads as low as one kilovolt ampere, voltages as low as 100 volts, and distances as small as 100 feet.

A new provision has been made for the calculation of power loss in a circuit, whereby it can be read at a glance along with the voltage drop, the whole process requiring but two minutes and the results being guaranteed accurate within one-fifth of one per cent. Other new features are the adaptability of the calculator to current determination, leading power factors, transformer regulation and direct current work, and also a special wire table which gives cost of bare and weatherproof wire as well as the usual information as to weights and ampere capacity.

The range of the transmission line calculator is as follows:

Systems	1, 2 or 3-phase or direct current.
Frequency	60 or 25 cycles
Load	1 to 20,000 kilovolt-amperes
Voltage	100 to 70,000 volts
Distance	100 feet to 100 miles
Power factor	1 to 100 per cent lagging or leading
Conductor material	Copper, aluminum or copper clad
Conductor size	No. 8 B & S to 1,000,000 CM
Conductor spacing	6, 18, 36 or 60 inches
Drop line or loss	0 to 40 per cent

Fixtures for Street Lighting Service.

The introduction of high candlepower Mazda lamps and the new conditions under which they operate required the design of an entire new line of fixtures to accommodate them properly. In general these fixtures as designed by the General Electric Company may de divided into three different classes; namely, bracket type, pendant type and ornamental type. The bracket and center span suspension fixtures, which are almost universally known, have been redesigned to accommodate the following reflecting equipment: Radial wave reflector, concentric reflector or concentric reflector with prismatic refractor.

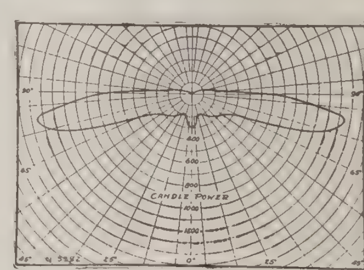
The pendant units have been designed in two different classes, known as Forms 1 and 2. The Form 1 unit has been designed to resemble the arc lamp in general contour and appearance. These units can be furnished with an opal diffusing globe, an opal diffusing globe and concentric reflector, a prismatic refractor and clear globe or a prismatic refractor. The Form 2 pendant units cost less than the Form 1. They are arranged to use a diffusing globe, radial wave reflector or a concentric reflector and prismatic refractor. Both the form 1 and Form 2 units are arranged to take a compensator, which is mounted under the dome and inside of the casing.

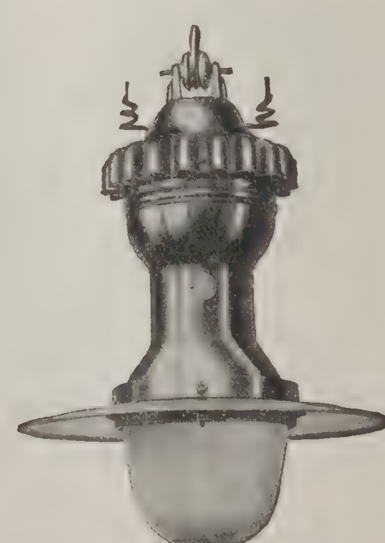
The ornamental unit has been designed to fill the demand for a highly ornamental unit where "White Way" lighting is desired and two different styles of ornamental units, known as the Forms 4 and 5, have been standardized.

Industrial Plant to Install Private Telephone System.

The relation of the telephone to efficiency in the management of the industrial plant has become so well understood that there is an ever increasing number of such plants using the telephone for expediting the carrying on of business routine. In recognition of this fact the J. I. Case Threshing Machine Company of Racine, Wisconsin, is preparing to put in operation an unusually complete private telephone system.

This company operates an exceedingly large plant in Racine, the principal buildings of which are about half a mile apart. In order to serve both parts of the organization in the most satisfactory manner, two complete switchboard equipments are to be installed. The switchboards, which will be of the Western Electric No. 1261 central battery private exchange type, will each have an initial equipment of 80 lines with capacity for additional lines to take care of future growth. Complete power plant, ringing, terminal and protective equipment will be used in connection with each switchboard.





New Designs of General Electric Street Lighting Fixtures for High Candlepower Lamps.

The two private exchanges will be connected by means of trunk lines running in lead covered cable. They will not, however, be connected to the city telephone service as the lines are to be used exclusively for internal business communications. Certain officials of the organization will, of course, require service outside of the plant and for this purpose a separate branch exchange switchboard will be operated in connection with the local telephone company's lines.

All telephone and construction material will be supplied by the Western Electric Company.

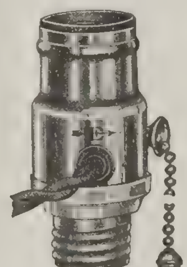
Meeting of Westinghouse Agent-Jobbers.

The midwinter meeting of the Westinghouse agent-jobbers was held at French Lick Springs, Indiana, December 3, 4 and 5. Matters of mutual interest were discussed and the following officers elected: President, N. G. Harvey, Chicago, Ill.; vice-president, S. L. Nicholson, Pittsburgh, Pa.; secretary, Max McGraw, Sioux City, Ia.; assistant secretary, H. T. Pritchard, Pittsburgh, Pa.; treasurer, J. E. McClernon, New York, N. Y.

The object of the association is to promote close relations between the manufacturer and the agent-jobbers, with a view to providing more efficient avenues for distribution of electric appliances, and to popularize the use of electrical apparatus and supplies to the end that the purchase of such articles may be made easy and convenient for the ultimate user.

A New Current Tap.

The accompanying illustration shows a current tap that has been designed by The Arrow Electric Company of Hartford, Conn. It consists of a pull socket with lamp base attachment and an outlet for an extension, the latter being controlled independently of the lamp in the pull socket.



THE ARROW ELECTRIC CURRENT TAP.

Electrical Construction News

This department is maintained for the benefit of contractors, dealers, manufacturers and consulting engineers.

ALABAMA.

WEST BLOCKTON. The Hills Creek Mining Co., is planning to make additions to its steam plant, installing electrical equipment to light the town.

GAYLESVILLE. The Walker Electric Co., of Rome Ga., has submitted plans to the city for the installation of an electric light plant, water works, and ice plant.

FLORIDA AND GEORGIA.

TARPON SPRINGS. The Pinellas Electric Light & Power Co., has applied for a franchise to do an electric light and power business.

DARIEN. The Darien Mfg. Co., has taken over the Darien Ice & Light Company's plant, and will establish an electric light and power plant. R. J. Downey is secretary of the company.

WADLEY. The city has voted $6,400 in bonds for an electric light plant.

ROCKMART. The city plans to install additional equipment in its electric light plant and provide 24-hour service.

KENTUCKY.

CARLISLE. The Carlisle Electric Light & Power Co., has secured a municipal electric lighting franchise.

HENDERSON. The city will make repairs to its electric light plant to the extent of $3,500. A boiler room was installed.

SCOTTVILLE. A lease on the Scottville Electric Light Plant has been purchased by J. W. Hood, and extensions will be made.

LOUISIANA.

RAYVILLE. The Peoples Light & Power Co., has been incorporated with a capital stock of $12,800. George Wesley and W. H. Smith are interested.

WINNFIELD. The Johnson Light & Ice Co., has been incorporated with a capital stock of $9,000 by J. M. Johnson and J. E. Johnson.

NORTH AND SOUTH CAROLINA.

WILSON. The city plans to make improvements to the electric light plant and street system.

FLORENCE. It is understood that the Carolina Electric Co., has been organized and will take over and consolidate the Florence Electric & Utilities Co., of Florence; the Marion Water & Electric Co., of Marion; the Darlington Water & Electric Co., of Darlington, and establish a central office in Florence. The new company is capatalized at $800,000, with an authorized bond issue of $2,000,000, of which $1,500,000 is to be used for improvements and enlargements of the purchased properties.

WESTMINISTER. It is understood that a hydro-electric plant is to be constructed three miles from Westminster by D. B. Craxley, of Greenville, S. C. Power will be transmitted to Westminister, Walhalla, S. C., and Seneca, S. C. These towns will be connected by a transmission line.

TENNESSEE.

DRESDEN. The city has voted $12,000 in bonds for the construction of an electric light system.

McMINNVILLE. The city is planning to construct a hydro-electric plant on the Collins River, about 3½ miles from this place. The present steam plant is to be used as an auxiliary. C. W. Pearsall is superintendent.

WEST VIRGINIA.

HUTCHINSON. The Monongahala Valley Traction Co., is going ahead with the construction of a gas-engine driven electric plant, which is to be used as an auxiliary to its steam-driven electric station. The capacity of the station will be 8,000 horsepower, three 1250 Kw. machines being installed, with arrangement for a fourth in the immediate future, and still furthur arrangements for six additional machines when required. The Bethlehem Steel Co., of Bethlehem, Pa., will furnish the gas engines, and the General Electric Co., the generators. The cost will be around $350,000.

LOGAN. The Logan Country Light & Power Co., has arranged to construct a steam power plant to cost around $750,000. Two 500 Kw. steam turbines with provision for an additional unit will be installed, and the station completed by September, 1915. Electricity will be transmitted to the Logan County coal mining field. Contracts have already been made with a number of plants. The Logan Country Light and Power Co., is owned by the General Utilities & Operating Company, of Baltimore, Md., and the plant is under the supervision of Francis R. Weller, Consulting Engineer of Washington, D. C.

Personals.

MR. JOHN H. ROEMER, present chairman of the Railway Commission of the State of Wisconsin, will, on February 1st, 1915, join the organization of H. M. Byllesby & Company, of Chicago, in charge of the extensive legal business of that organization and its allied interests. H. M. Byllesby & Company are engineers and managers of public utilities throughout the country from the Mississippi Valley to the Pacific Coast. Mr. Roemer has served on the Wisconsin Commission since the time its duties were enlarged to embrace the regulation of utilities other than steam railways in 1907.

MR. L. S. MONTGOMERY, formerly district manager of the National Metal Welding Company in the South, and now Canadian representative together with his brother, Mr. F. S. Montgomery, advertising manager of the company, spent Christmas week in Atlanta.

MR. N. J. GOULD, president of the Gould Mfg. Co., of Seneca Falls, N. Y., has recently made an extensive business trip throughout the South and SouthWest, visiting the oil fields of Louisiana and Oklahoma. Mr. Gould is very optimistic over conditions and was impressed with the possibilities in the South. While in Atlanta he established a branch office in 714 3rd National Bank Building, which will be in charge of Mr. O. B. Tanner, who has represented the company in the South heretofore.

CLINTON G. REED and CHARLES LEONARD have formed a partnership to deal in electrical material, representing manufacturers in Baltimore, Washington and vicinity. Both are former employes of the Westinghouse Electric & Manufacturing Company, well posted on trade conditions and personally acquainted with the trade. This concern will be pleased to hear from manufacturers who desire representation as sales agents and should be addressed at No. 705 American Building, Baltimore, Maryland.

MR. BYRON T. BURT has resigned as general manager of the Chattanooga and Tennessee River Power Company. He will be succeeded by George S. Baker, who has been auditor of the company since it opened offices in Chattanooga. Mr. Burt will go to Buenos Aires early in 1915, as manager of the South American Trading Company, and will open the main office of that concern for the sale of American manufactures in Argentina. He has been conspicuous in Chattanooga business circles for several years, having been manager of the old Chattanooga Electric Company until its consolidation with the Chattanooga Railway and Light Company. When the Chattanooga and Tennessee River Power Company was organized to construct the Brady power plant at Hale's Bar on the Tennessee river, he was made general manager. He is an electrical engineer of wide reputation and a member of several national scientific organizations. Mr. Burt enjoys an enviable reputation among Chattanooga business men and manufacturers.

MR. NORMAN B. HICKOX, formerly manager of the Greenwood Advertising Company, of Knoxville, Tenn., has accepted a position with the Thomas Cusack Company, of Chicago.

INDUSTRIAL ITEMS.

THE ROBBINS AND MYERS COMPANY, of Springfield, Ohio, reports that the fire at its plant on Dec. 12 did not disturb plant operation. The report follows:

"Our electrical plant was not injured in any way. The only damage was in two of the buildings in our foundry plant and arrangements were made with adjacent manufacturers within a few hours after the fire occurred, by which they will furnish foundry facilities for our force until our foundry buildings can be replaced. We will experience but little inconvenience and the only delay in our production was the few hours it took to transfer our patterns to these adjoining foundries. As we have a large stock of castings on hand, this slight delay will not affect our deliveries in the least. All of the buildings and equipment damaged by the fire were fully covered by insurance and early the next morning there was a large force at work clearing the way for a new, modern foundry plant.

MAIN ELECTRIC MFG. CO., 215-221 So. Beatty St., Pittsburgh, Pa., has issued catalog No. 20, which takes up a complete line of isolated electric lighting and power plants for country homes, estates, hotels, public garages, resorts, factories, etc. A complete plant includes engine, flywheel type dynamo, storage battery, and marble switchboard. These plants can be arranged when so specified to be automatically started up. Provision is also made so as to light and charge at the same time and lights taken direct from the dynamo are said to be free from any perceptible fluctuation of voltage. These plants are built in capacities from ¼ Kw. to 25 Kw.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, announce the removal of their New York office from 145 Chambers St., to 30 Church St., Room 400 E. The stocks of fans and motors will be handled at their warehouse, 155 Hudson St.

THE ELECTRICAL ENGINEERS EQUIPMENT COMPANY, of Chicago, Ill., has issued bulletin No. 103, on bus bar supports, and No. 104, on miscellaneous fittings.

THE COLONIAL SIGN AND INSULATOR CO., of Akron, Ohio, is distributing a booklet describing different porcelain specialties. This company manufactures a complete line of standard wiring tubes, knobs and cleats, as well as third rail insulators. A new product has been added, known as all-porcelain pot heads, designed as an outdoor terminal for lead covered cables. About 3000 of these pot heads are used in the city of Cleveland alone.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, have appointed Mr. C. R. Hunt and Mr. Guy H. Gibbs to take charge of their exhibits at San Francisco and Sandiego respectively. Mr. Hunt has for the past five years been district wiring specialist of the Chicago office of the General Electric Company. Previous to this time he was connected with the Crocker-Wheeler, Switchboard Equipment and Cutler-Hammer Companies. Mr. Hunt is a native of California and a graduate of the University of California. At the close of the Panama-Pacific Exposition he will maintain a permanent office in San Francisco.

Mr. Gibbs has for the past five years been connected with the Western Electric Company as power equipment specialist at their Cincinnati and Buffalo offices. Previous to this he was for eight years connected with the Westinghouse Company at their Philadelphia and Cincinnati offices. During the years from 1896 to 1901, before making his connection with Westinghouse, Mr. Gibbs was a manufacturers' agent in Great Britain and on the continent of Europe.

ELECTRICAL ENGINEERING

Vol. 47. FEBRUARY, 1915. No. 2.

Electrical Equipment of the Erlanger Cotton Mills Using 1308 Individual Motor Drives

BY GEORGE WRIGLEY, ELECTRICAL ENGINEER WITH J. E. SIRRINE, GREENVILLE, S. C.

IN what follows the features of a modern cotton mill electrical installation for power and lighting are described and shown by the accompanying illustrations of equipment in the different departments of the Erlanger Cotton Mills at Lexington, N. C. Individual motors for each machine have been installed in this mill as far as practicable in the present state of the industry. The mill was constructed for the manufacture of cotton cloth and conversion into underwear and has at present an equipment of 25,600 spindles and 680 looms. It was arranged for a future extension and an ultimate equipment of 40,960 spindles and 1,100 looms.

The management has recently decided to proceed with the extension of the plant and complete the above contemplated installation. Contracts have been awarded for the additional building and machinery and work will be commenced at once. In view of the highly satisfactory operation of the individual drive, it has been adopted for the extension and the motors for the respective new departments will be duplicates of those already in operation and carry out the original methods of arrangement. The new equipment will include 490 alternating current motors ranging in size from ⅓ to 100 horsepower with suitable control devices, making the total installation comprise an aggregate of 1308 motors.

MOTOR CIRCUITS AND ARRANGEMENTS.

The feeder circuits for the mill are run in tunnels wherever practicable, a main tunnel running the full length of the buildings with the necessary sub-tunnels at proper locations. These tunnels are of sufficient size to allow the installation of wires and such periodic inspections as desirable. Risers are carried up from the tunnels in conduit to the different departments. All heavy wiring in the tunnels is of white slow burning insulation, supported on porcelain cleats, which are in turn secured to wooden cleats. The wiring for tunnel lights is carried in rigid

FIG. 1. THERE ARE 680 LOOMS IN THIS ROOM, EACH DRIVEN BY A ONE-THIRD HORSEPOWER MOTOR. NOTE THE GOOD NATURAL LIGHTING AND OPPORTUNITY FOR ARTIFICIAL LIGHTING WITH CEILINGS FREE FROM BELTS AND SHAFTING.

conduit. The weave room floor, shown in Fig. 1, which rests on tar concrete, is provided with channels formed by the omission of heavy planking at suitable spacings. In these channels the circuits to the loom motors are run in rigid conduit, with simple floor boxes under each loom motor. In the spinning room shown in Figs. 3 and 4, the tunnels are located directly under the motors, and short risers of rigid conduit connect the tunnel mains to the fuse condulets protecting the motors.

MILL LIGHTING.

The mill is lighted throughout with 60-watt tungsten lamps equipped with intensive type steel reflectors, having aluminum reflecting surfaces. Lamps are hung at a height of approximately 14 feet above the floor in the spinning and card rooms, as shown in Figs. 4 and 6, and 9 feet in the weave room. This system gives the proper amount of light for the work, with a pleasing absence of glare or intensive light sources in the line of vision. The use of one standard size lamp and reflector makes for ease in maintenance. The lighting system is controlled, in the several departments, by Detroit iron clad switches mounted at convenient locations on the walls.

The Erlanger Cotton Mills and Mill Village at Lexington, N. C.

In the present mill there are 818 motors installed, ranging in size from 1/3 horsepower to 100 horsepower. The aggregate horsepower of motors installed is now 1259. These figures do not take into account the numerous small motors on the air conditioning heads.

Each loom is driven, through gearing, by a 1/3 horsepower motor, as shown in Fig. 5, running at 1800 revolutions per minute and controlled by a snap swith. The warp spinning frames are driven by 7½ horsepower and the filling spinning frames by 5 horsepower, 1800 revolutions per minute motors, directly connected to the cylinders and controlled by non-automatic oil switches. In addition to the above, individual motors are used on the pickers and spoolers. A set of enclosed fuses in suitable condulet is provided for each small motor. The card room machinery and some of the other departments are driven by large motors, through belting and shafting, as shown in Fig. 6.

All the large motors are of the squirrel cage type and controlled by hand operated starting compensators, equipped with series trip coils, no-voltage release coil and arranged for conduit wiring.

POWER PLANT EQUIPMENT.

Current is generated at 240 volts, 60 cycles, 3-phase, through the installation of a 1500 Kw. turbo-generator of the horizontal 4-stage type, rigid frame design, with three points of support. The guarantee of this machine at full load with three inches absolute back pressure and 175 pounds dry steam is 18.5 pounds of steam per kilowatt hour.

Connection between armature terminals of the generator and the switchboard is made with copper busbars run below the turbine room floor. These busbars are protected by separators and top of asbestos wood, and are mounted on slate block insulators supported on pipe work. Slate slabs are used in the openings of turbine foundation and through the concrete floor to fit neatly around the connecting busbars.

The switchboard with panels of natural black slate, is arranged with two exciter panels, one generator panel and

Fig. 2. Picker Room Arranged for Convenience in Working.

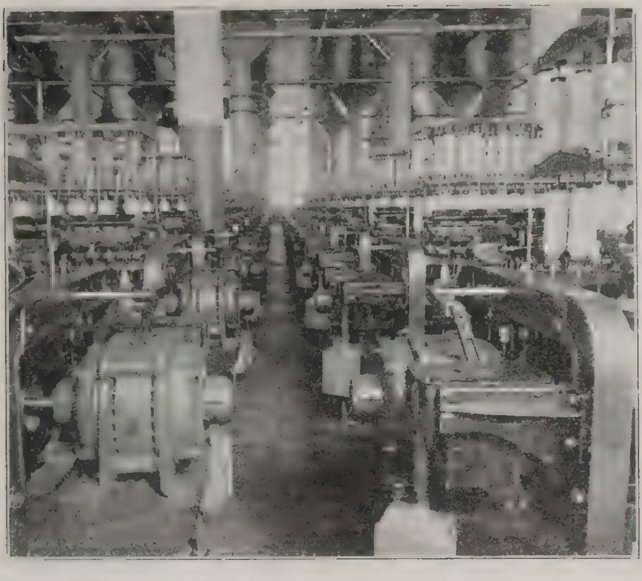


Fig. 3. View of Spinning Room Showing Arrangement of Motors, Oil Switches and Cut-Out Condulets.

Fig. 4. View of Spinning Room Showing Arrangement of Frames and Lighting.

six feeder panels. The instrument equipment is as simple as possible, consistent with an accurate knowledge of operating conditions. A watthour meter on the main generator panel gives a record of the total output of the unit.

No main switch is installed in the generator circuit, the leads from the armature connecting directly to the switchboard busbars. A circuit breaker with auxiliary discharge clip is connected in the generator field, and operated through a suitable relay from current transformers in the main generator leads. This arrangement is designed as a protection against serious overload, or short circuit conditions. On one of the generator panels a ground detector is provided, consisting of three indicating lamps mounted in the panel and flush with its front surface. Each lamp is connected to one phase of the busbars, with the neutral of all three lamps connected to ground. Instrument testing terminals are provided on the generator panel, for checking with portable instruments.

The feeder control is provided for by triple pole, air break switches and enclosed fuses, these fuses being mounted on slate slabs in the rear of the panels and accessible for renewal. Several of the feeder circuits are provided with double throw features, so that power purchased from an outside source may be used, if desired, for operating certain sections of the mill motors or lights at such times as the turbine unit is not running.

The exciter equipment consists of a steam turbo set of 15 Kw. capacity and a motor generator set of 14 Kw. capacity. Both sets are flat compound wound for 125 volts.

The boiler plant contains four Manning type, vertical, fire tube boilers of 250 nominal B. H. P. rating each, with space provided for a future unit of the same rating. The flue gases are passed through a fuel economizer of 4707 square feet heating surface, to a radial brick stack having a diameter of 7 feet 6 inches and a height of 165 feet. Boiler feed pumps, make-up pumps and heater are installed in the boiler room.

Steam at 175 pounds pressure, and approximately 30 degrees F. natural superheat, is piped to the Curtis steam turbine in the turbine room, which has a normal rating of 1500 Kw., and is direct connected to a generator of the same rating operating at 3600 revolutions per minute.

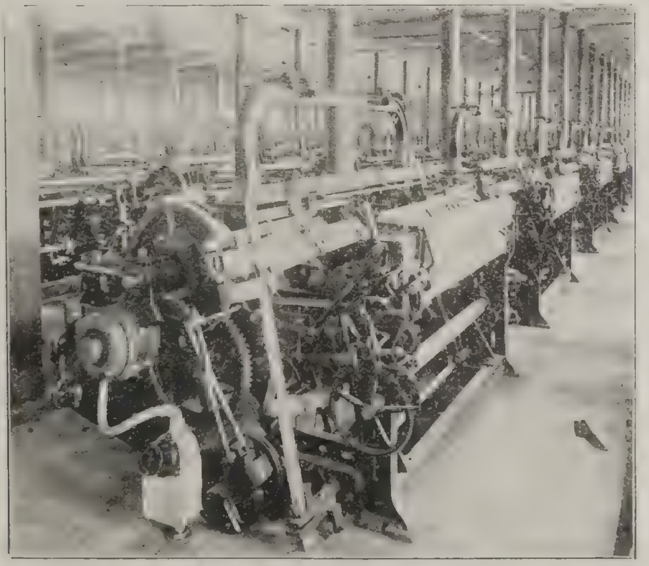


Fig. 5. View of Looms Showing Method of Mounting Motor, Snap Switch and Cut-Out Condulet.

Fig. 6. Card Room Showing Group Drive Through Shafting.

The turbine exhaust is condensed in a surface condenser, with motor driven centrifugal circulating pump and steam driven air pump, placed in the turbine room basement. An indicating steam flowmeter placed in the 6 inch steam line to the turbine, indicates the total pounds of steam per hour being used by the prime mover.

The circulating water for the condenser is cooled by a spray system of 30 nozzles installed over a 1,200,000 gallon reservoir. Evaporation is replaced by a motor driven triplex pump taking its supply from a small branch.

MILL VILLAGE LIGHTING.

The streets of the mill village are lighted with 100 candle power, 6.6 ampere series tungsten lamps, supported by galvanized brackets and fitted with radial wave reflectors. Lamps are placed at a distance of approximately 150 feet apart.

A constant current transformer furnishes current for the series street lighting of the village. In the switching arrangement for this transformer the customary plug switches are not used, the primary side being controlled by an air break switch, and the secondary side having no switch. A simple grill work fences off the rear of the switchboard and constant current transformer from the main floor of the turbine room.

In the operatives' dwellings a 60-watt lamp is provided in each room, with an additional lamp for the porch. Current for these dwellings is stepped up to 2300 volts at the power plant, distributed on a line of poles running in the rear of the buildings and stepped down by transformers feeding groups of convenient size from secondary busbars.

FIG. 7. POWER STATION CONTAINING 150 KW. TURBO-GENERATOR, STEAM EXCITER SET AND SWITCHBOARD.

Lights are also furnished for the welfare building, the church and the school.

All cross arms of the pole line are made of heavily galvanized angle iron. Porcelain insulators of heavy design and galvanized iron pins are used to support the 2300 volt wires. Pierce racks are used for the support of the secondary mains. Each transformer is protected by a pair of compression type lightning arresters and has its secondary grounded.

Practical Methods for Laying Out and Building Transmission Lines

BY E. B. HOOK, JR., SUPERINTENDENT OF CONSTRUCTION, GEORGIA RAILWAY AND POWER COMPANY.

WITH the size and type of pole selected, we are prepared to estimate what pole spacing to use, and can then get up a bill of material and have it shipped out on the job. It is readily understood that poles should be spaced at the maximum safe distance so as to economize as much as possible on material and labor. If there are forty poles to a mile of line instead of fifty, all material except the conductors is proportionately decreased, as well as labor.

The engineer must exercise care, however, in determining his line stresses, and not overdo the pole spacing. The stresses which the line must be designed to sustain are of three general classes: 1. The dead weight of wires, insulators, cross arms, and ice and sleet loading which may be supported by the wire. 2. Wind pressure upon every part of the line including poles or other supports. 3. Tension of the wires and variation of this tension due to temperature changes.

The stresses upon the pole produced by the dead weight of wires, insulators, cross arms, etc., are negligible except in special cases, because if the poles are sufficiently strong to withstand the bending stresses, they must necessarily be strong enough to withstand compression due to weight of wires, insulators, cross arms, etc. Therefore, for the solution of the problems on hand we need only consider the two latter classes of stresses for poles, which are designed as cantilever beams fixed in the ground and loaded with wind on the wires at the height of the cross arms and on the pole itself as a distributed load. In the case of anchor poles, the tension of the wires, or the difference in tension on either side of the pole comes into the calculation.

The line stresses which cocur, due to changes in temperature and to ice and wind loads, must be assumed to some extent on account of the wide variation encountered in different localities. For cylindrical surfaces the amount of wind pressure is two-thirds that exerted on a flat surface of a width equal to the diameter of the cylinder. For all practical purposes it is safe to assume that the maximum wind pressure is exerted when the wind is blowing at right angles to the line. Conservative authorities recommend a value of thirty pounds per square foot allowable for wind pressure in exposed places. The following formula can be used for wind pressure: where $V =$ velocity of wind in miles per hour; $P =$ pressure in pounds per square foot; $B =$ barometric pressure in inches.

For flat surfaces—

$P = 0.004 \times (B \div 30) \times V^2$.

For the projected surface of a cylinder—

$P = 2/3 \times .004 \times V^2 = .0027V^2$

Solving for P with a wind velocity of sixty miles per

Note: This article is a continuation of one in the January issue.

hour, P = 9.72 pounds pressure per square foot. With the value of thirty pounds per square foot as recommended above, we have a safety factor of 3, which is quite sufficient for wires or cables, pins, insulators, conductor attachments and guys.

No bending stress exists at the highest point of attachment, and the section at this point is determined by the sheer and practical considerations. Downward from this point, the section increases with the growing moment in such proportion that the resulting maximum unit stresses shall be constant. If then, M = bending moment at any horizontal section; I = moment of inertia about the axis of gravity perpendicular to the resultant outside force; E = the disdistance of the remotest fibre from this axis; and

S = permissible unit stress, then S = M (E ÷ I) which is constant.

For wooden poles the top section is of the minimum practical size, the bottom section is determined by the above equation, and the two connected by a conical surface. Instead of applying this formula to the poles, the length, top, and ground line dimensions are determined and the poles applied to these required dimensions. The poles are inspected when unloaded on the job, and if found to be of live trees, reasonably straight and free from knots, woodpecker holes, sap rot or internal decay, well proportioned with bark pulled off, and fitting the specifications as ordered by class and length, the inspector may safely accept them.

Poles are usually divided into three classes according to the use for which they are intended: Class "A"; for heavy transmission lines, or heavy distribution lines. Class "B"; for light transmission lines or ordinary distribution lines. Class "C"; for very light distribution lines or light secondary lines. The dimensions of poles in each class are as follows, the "top" measurement being the circumference at the top of the pole, and the "butt" measurement being the circumference six feet from the butt:

Length of poles in feet.	Top in inches.	6 ft. from Butt in inches.
Class "A"		
30	24	40
35	24	43
40	24	45
45	24	48
50	24	51
55	22	54
60	22	57
Class "B"		
30	22	36
35	22	40
40	22	43
45	22	47
50	22	50
55	22	53
60	22	56
Class "C"		
30	20	33
35	20	36
40	20	40
45	20	43
50	20	46

In ordering poles, their destinations should be carefully considered, and when the line parallels a railroad quite an appreciable amount of time and labor can be saved by having poles unloaded at frequent intervals along the route. In some cases where the railroad may be a branch line and a switch engine is accessible, it is often economical to have cars of poles hauled out from the station and unloaded at cross roads or other places convenient to the lines. Care should be exercised to see that flat cars are furnished by the railroad, and not high sided coal cars or gondolas. Poles shipped in these cars prove very expensive to unload.

On the line under consideration, as stated above, 50 ft. creosoted long leaf yellow pine poles of Class "A" were used. By referring to the table, it is seen that these specifiactions call for a top circumference of 24 inches and butt circumference 51 inches. After consideration of the above mentioned stresses, the poles were spaced a distance of 175 feet on straight runs across comparatively level ground, and 100 to 150 feet on corners, curves or steep inclines and other points of exceptional stress.

In average soil of comparatively solid ground, all poles should be set in holes of the following depths:

Length of pole in feet.	Straight lines.	Curves, Corners of points of extra stress.
30	5′—0″	6′—0″
35	5′—6″	6′—0″
40	6′—0″	6′—6″
45	6′—6″	7′—0″
50	6′—6″	7′—0″
55	7′—0″	7′—6″
60	7′—0″	7′—6″
65	7′—6″	8′—0″
70	7′—6″	8′—0″
75	8′—0″	8′—6″
80	8′—0″	8′—6″

For special construction on hillsides, soft or marshy land, these depths may be increased to meet the conditions of extra strain. The holes must be dug large enough to allow about six inches of space around the poles so that tamping may be effectively done. When rock is encountered, it is often necessary to blast out the holes. A steel drill about an inch and a quarter in diameter can be used for drilling the shooting hole, and in most cases the drilling has to be done by hand with sledge hammer. Usually a hole from 18 inches to 3 feet is drilled and loaded with two or three sticks of dynamite which is exploded with fuse and cap, or with a high tension magneto built for the purpose. Very often several shots are necesary to open the hole to the required depth. In marshy land a barrel with the bottom knocked out is used to prevent the sides of the hole caving in, and is pushed down as the hole is dug. In very wet swamps where it is impossible to dig a hole, the pole may be set by sharpening the butt, standing on end and giving a lateral rocking motion until it sinks to a safe depth. Cross timbers should then be bolted to the base to secure stability and prevent further settling.

In wooded country it is often necessary to clear off the righ-of-way before setting the poles. All shrubbery and undergrowth should be cleaned off a distance of ten or fifteen feet on either side of the center line of poles. This improves the appearance of the line, and facilitates access for line inspection and repair, and also reduces the risk of grass fires getting to the poles. All trees that in any way menace the line should be cut and cleared off the right-of-way.

The next section of this article will take up methods for setting poles.

Construction and Operation of Rotary Converters

BY WILLIAM R. BOWKER.

In point of construction the rotary converter is practically the same as the direct current generator or motor, with taps taken from the back of the armature and connected to slip rings mounted on the armature shaft, which shaft carries the usual commutator and brushes of a direct current machine. The armature of the rotary converter has but one set of windings connected to the commutator at one end while at the other end the taps taken from the windings are connected to two, three, four or six slip rings, according to the nature of the alternating current delivered to or taken from the machine.

This single set of armature windings receives the incoming primary current, and at the same time generate the secondary current to be delivered to the secondary external circuit. The ratio of the voltages and currents in the windings of a rotary may be considered as follows:

The actual effective voltage on the A. C. side, supplied to the D. C. side with a constant pressure of 100 volts $= 100/\sqrt{2} = 100/1.41$ or 70.7 volts. Thus the A. C. voltage is 0.707 times the direct current voltage, for a single-phase converter. The effective alternating voltage with a three-phase converter eqnals (D. C. volts $\times$ .707 $\times$ sin 60 degrees.) or $(.707 \times \sqrt{3}) \div 2 =$ D. C. volts $\times$ .612

Conversely if we were to supply the single-phase side of a rotary converter with 70.7 volts alternating supply, we would receive at the secondary direct current end approximately 100 volts direct current, any value not exactly 100 being due to wave deformation losses in the armature, and slight losses due to influences of like character. For a three-phase converter the value of the sine of the angle of 60 degrees is $\sqrt{3}/2 = 1.732/2$, and if we wish to get 550 volts direct current from a three-phase generator, it would be necessary to supply it with $550 \times .707 \times \sqrt{3}/2 = 550 \times .707 \times .612 = 336$ volts.

The true conversion ratio depends upon the following: (1) The flux distribution around the armature periphery. (2) The ratio of pole span to pole pitch. (3) Power factor. It also depends to a slight extent on the position of the brushes on the D. C. side, which should always be fixed in the neutral position.

The ratio of the direct currents to the line currents on the alternating current side is in the inverse ratio of the voltage, assuming the losses are negligible and the power factor is unity. The input and output currents would, under these conditions be equal, in which case the product of (volts $\times$ amperes) on the D. C. side = volts $\times$ amperes on A. C. side. As the ratio of the A. C. to D. C. voltage is .707 to 1; or 1 to 1.414 then the A. C. amperes = D. C. amperes $\times$ 1.414.

Let E = D. C. volts and C = D. C. amperes; also V_1 C_1 ; V_2 C_2 and V_3 C_3 the volts and amperes on the A. C. side of a single, two, and three-phase converter respectively. Then by equating the D. C. and A. C. factors, and assuming unity power factor, we get E. C. $= V_1 C_1$; E. C. $= 2 V_2 C_2$; E. C. $= \sqrt{(3 \times V_3 C_3)}$ and since a reference to the voltage ratios gives $V_1 = .707$ E; $V_2 = .707$ E; and $V_3 = .612$ E; then the ratio of the currents on the A. C. side is given by $C_1 = E \div .707$; $C_2 = (1/2 \times 1/.707) \times E$; and $C_3 = (1/\sqrt{3} \times 1/.612) \times E$.

The ratio of the currents would then be:
Continuous current = 100
Single-phase = 141.4
Two-phase = 70.7
Three-phase = 94.3

The following table represents the numerical value ratios of the currents and voltages; also the angle between the slip ring connections; obtained with different converters. These values are purely theoretical, and seldom obtained in practice, due to the fact that they do not take into account the effects of (1.) Armature impedance; (2.) power factor and (3.) wave form.

Relation of Voltage and Current in Rotary Converters.

Nature of Current	Number of Slip-Rings.	Angle Between Slip-Ring Connections.	Volts Between Rings.	Line Amperes.
Direct	....	....	1	1
Single phase	2	180°	.707	1.414
Two-Phase	4	90°	.707	.707
Three-Phase	3	120°	.612	.943
Three-Phase	6	60°	.612	.943
Six-Phase	6	60	.354	.472

The values for current in this table are obtained when the circuit is "non-inductive." In the case of an inductive circuit, the resultant phase difference would give rise to wattless as well as useful working currents, and for an equal output of power the line current would be increased by dividing it by the cosine of the angle of lag.

As previously stated, for a single-phase converter there are two slip-rings and brushes; for a two-phase, four rings; for a three-phase, three or six rings.

In Figs. 1, 2 and 3 the connections are shown that are used in practice to obtain the above named phase combinations. The armature is represented with a core, over which is distributed a continuous ring winding which is to all intents and purposes a continuous current generator armature in which the direct current commutator and brushes are absent. The object of this is to show the angular displacement of the back end connections or taps and slip-rings.

In the case of a single-phase machine, taps are taken off at 180 degrees as shown in Fig. 1. If we connect an additional pair of slip rings to taps connected at right angles to the first two, we can obtain two separate or two-phase

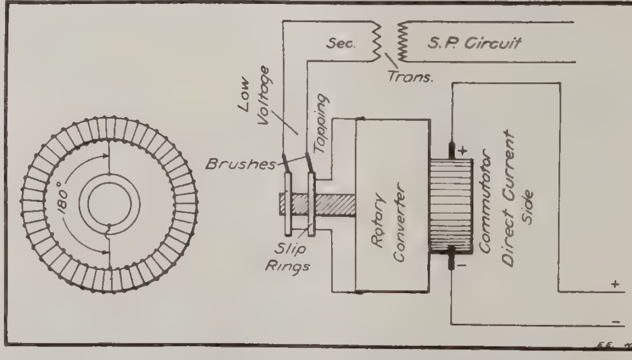


Fig. 1. Arrangement of Single-Phase Rotary Converter.

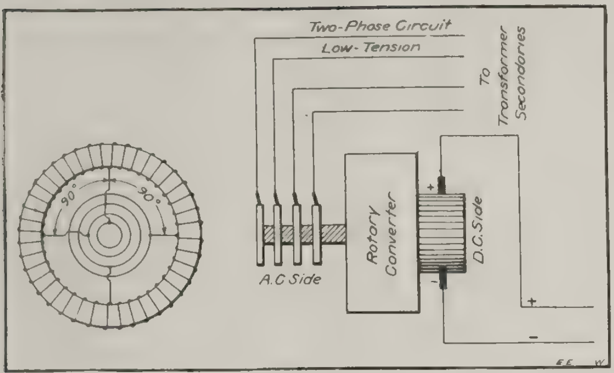


Fig. 2. Circuits for Two-Phase Rotary.

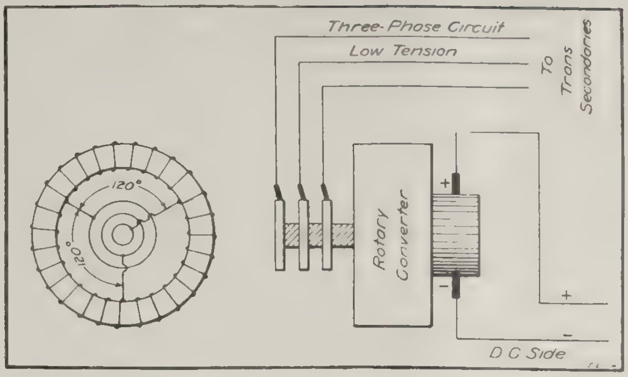


Fig. 3. Circuits for Three-Phase Rotary.

currents in quadrature or with a phase displacement of 90 degrees to each other, as seen in Fig. 2. Similarly if three points, 120 degrees apart are connected to three slip rings as shown in Fig. 3, then three-phase currents are obtained with a phase difference or lagging of 120 degrees. On the same principle, six taps with an angular displacement of 60 degrees, connected to six slip-rings, constitute a six-phase combination.

Rotary converters when driven by mechanical power will also give direct current at the commutator end and single, two, three or six-phase current at the other end, and when so employed the machine is technically known as a double-current generator. If direct current is supplied to the commutator end, the machine armature will mechanically revolve as an ordinary direct current motor and at the same time deliver alternating current to an outside circuit, through the arrangement of the taps, slip-rings and brushes.

The speed of a rotary converter follows the well known law as represented by the formula,

$$E/N = (60 \times 10^8) \div (p \times n)$$

Where N = induction or field flux value; E = the applied emf.; n = number of armature conductors; and p = number of poles.

From this formula it will be seen that the speed is governed by E and N; and is therefore affected by armature reaction. When supplying alternating current the armature reaction due to lagging currents has a de-magnetizing effect on the field and the speed is liable to become excessive and cause great variations in the frequency, unless means are employed to prevent it.

A method of remedying this difficulty is to excite the field separately with a small generator, this being driven by an induction motor, supplied with current from the slip-rings of the rotary. This exciter works at very low saturation, and consequently any change in the speed causes a considerable change in its emf., hence a steady speed is maintained.

When the rotary is supplied with alternating current, it runs as a synchronous motor, and its speed is then fixed by the number of poles and the frequency of the supply circuit. The number of revolutions per second = F/P where F is the frequency, and P = half the number of poles or the number of pairs of poles. Thus if the frequency is 25 cycles per second, and the machine has six poles, then revolutions per second = 25/3 or 8.3.

Although as already stated, it is possible to obtain converters for single, two or three-phase currents, the single and two-phase are not often met with in present-day practice, therefore it is not necessary to deal with them except in a brief manner.

As regards the single-phase type of converter, it has several disadvantages: (1.) Considerable variations of armature reaction, which is a most important factor in the operation of converters. (2.) Unequal distribution in its heating effects. (3.) Sets up a periodic fluctuation in the current on the direct current side; and (4.) It is not self-starting from the A. C. side.

In the case of a two-phase converter, the heating is more equally distributed throughout the armature, and the tendency to cause fluctuations in the current on the D. C. side is not so great. It has the distinct advantage of being self-starting. For these reasons, it is more often met with than the single-phase type, but both types compare unfavorably with the great advantages possessed by the three-phase converter.

There are three different emf.'s to be taken into account in a converter. (1.) The emf. applied to the slip-rings. (2.) A counter electro-motive-force induced in the converter armature, which is proportional to the field excitation. (3.) The impedance emf. which represents the volts lost due to the reactance and resistance of the armature.

The applied voltage depends upon the generator. The counter emf. depends upon the field-excitation, and is constant at all loads. The impedance emf. is proportional to the current, and varies with the load. The work done by a converter is equal to the product of the current taken by it, and the projection of the counter emf. on this current, which, at no load is at right angles to the counter emf. The converter input equals the product of the impressed emf. and the projection of the current on it, and if we assume that no energy is consumed, the current is in quadrature with the applied voltage. Now, at any moment, there are three separate emf.'s in the system their sum being always zero. Also, at any instant, the sum of the counter emf. and reactance emf. equals the applied voltage.

As the counter emf. is less than the applied voltage when a converter is under-excited, the reactance emf. must be in phase with it, and since the current is always 90 degrees ahead of the emf. of self-induction, it is 90 degrees behind the applied voltage and would consequently be lagging.

If the field excitation be increased, so that the counter emf. is higher than the applied voltage, the reactance emf. would be in phase with this latter quantity, the current in this case leading instead of lagging.

The operating characteristics of the rotary converter, and the methods of exciting will be taken up in the next section of this article.

The Operation of Line Drop Compensators on Three-Phase Lines

BY MERWYN C. RODIE.

THE operating principles of the line drop compensator are shown in Fig. 1 as applied to a single phase line. It consists of a resistance and a reactance coil in series and a small transformer, the higher voltage side of which is connected to the coils, a voltmeter, a part of the resistance coil, and a part of the reactance coil being connected in series across the line. The compensator is so set that the voltage drop in the portion of the resistance coil which is in series with the voltmeter equals the (RI) drop for the line and the drop in the portion of the reactance coil in series with the voltmeter equals the (ωLI) drop of the line.

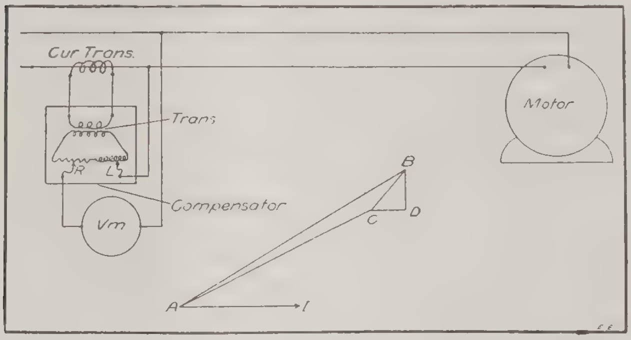


Fig. 1. Diagram Showing Operating Principles of Line Drop Compensator.

The current in the compensator is practically in phase with the line current. The voltage drop in the resistance coil is therfore in phase with the (RI) drop in the line and the drop in the reactance coil is 90 degrees ahead of the current and in phase with the (ωLI) drop in the line.

In the diagram, let AB represent the sending end voltage and (AI) the line current. Then the vector (DB) may be used to represent in phase as well as magnitude either the reactance drop in the line or the drop in the portion of the reactance coil which is in series with the voltmeter. Likewise (CD) may be used to represent the (RI) drop in the line, also the (RI) drop taken off from the compensator, and by subtracting vectorially from (AB) we get (AC) which must represent the voltage across the voltmeter terminals and also the voltage at the end of the line. Thus by the use of a line drop compensator the voltage at the receiving end of the line may be read directly off from the generating station voltmeter.

On high voltage lines potential transformers are used. The ratio of the potential transformer then must be taken into consideration in setting the compensator. If the potential transformer has the same ratio as the power transformer at the end of the line and if the impedance of the power transformer as well as that of the line is considered in setting the compensator, then the voltmeter will read the low tension voltage at the receiving end.

A vector diagram such as that shown in Fig. 1 will also apply to a three-wire, three-phase line with a balanced load, connected either star or delta. There is this slight difference, however, that in the three-phase line (CD) and (DB) are equal to ($\sqrt{3}$ RI) and ($\sqrt{3}$ XI) respectively instead of (2RI) and (2XI) as in the case of the single-phase line. In both cases (I) is the current per wire, and (R) and (X) resistance and reactance per wire, and (AB) and (AC) represent voltage between wires at the sending end and at the receiving end respectively. Then with the correct voltage relations three-phase line drop compensation may be obtained by means of a single-phase "dummy line."

In Fig. 2 this scheme is carried out, using two current transformers. The secondaries are shortcircuited thru the low tension side of the transformer in the compensator. They are connected in parallel with reversed connections so that the current in the compensator is the vector difference of the currents in the current transformer secondaries. It is numerically equal, in a balanced system, to ($\sqrt{3}$) times the current in either secondary. As may be seen from Fig 2 (b) the compensator current is in phase with the (XZ) voltage at unity power factor and in general it leads or lags behind this voltage by the angle between line current and voltage measured from line to an imaginary neutral (N) that is, by the angle whose cosine is the three-phase power factor. This gives the proper phase relation for the "dummy line" furnished by the compensator.

The voltage relations are represented vectorially in Fig. 2 (c). It is evident that since the current in the compensator corresponds to $\sqrt{3}$ times line current, the compensator should be set corresponding to the resistance and reactance per wire in order to give voltage corresponding to ($\sqrt{3}$ RI) and ($\sqrt{3}$ XI).

A method of obtaining compensation on a three-phase line with the use of only one current transformer is illustrated in Fig. 3. The current transformer is connected in one of the legs of the phase from which the potential is taken. By the vector diagram Fig. 3 (b), it may be seen that the current in (Y) lags behind the (YZ) voltage by

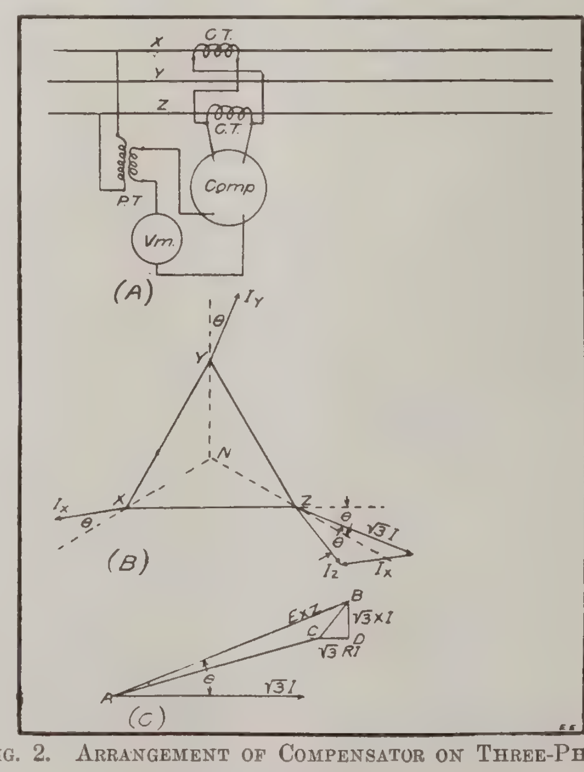


Fig. 2. Arrangement of Compensator on Three-Phase Line with Two Current Transformers.

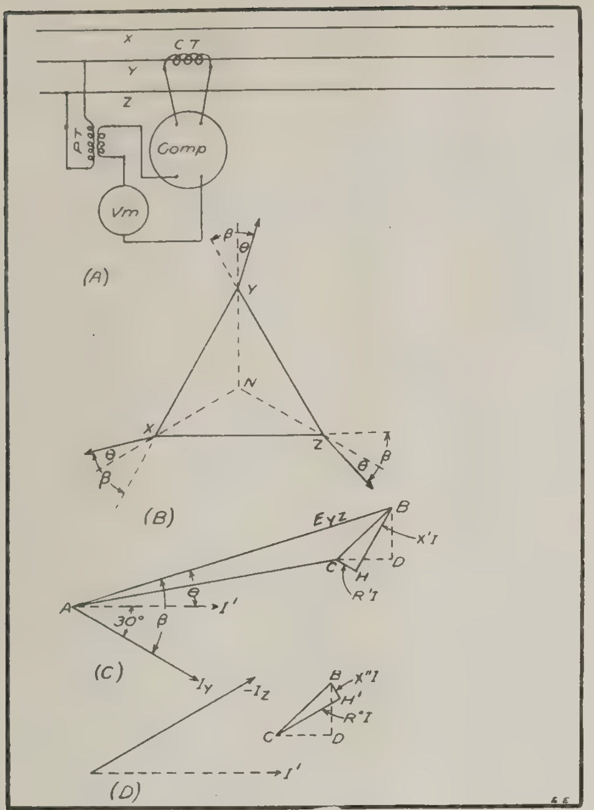


FIG. 3. ARRANGEMENT OF COMPENSATOR ON THREE-PHASE LINE WITH ONE TRANSFORMER.

the angle (β) which is 30 degrees greater than the phase angle (ϕ). This condition then does not give the proper phase relation for obtaining a miniature circuit of the voltage relations represented by the diagram ABCD. However, in order to get the receiving end voltage (AC), it is only necessary to subtract the voltage drop vector (CB) irrespective of how this vector is obtained. Correct compensation is then obtained at any value of power factor.

The resistance side of the compensator is given a setting (R^1) found by dividing the voltage represented by (CH) by the current (I) through the resistance coil of the compensator, and the reactance side is given a setting, (X^1), corresponding to the vector (HB) divided by the current, (I). First the vectors ($\sqrt{3}$ RI) and ($\sqrt{3}$ XI) are found from the known resistance and reactance of the line. These give the triangle CDB. Having the hypotenuse (CB), the triangle (CHB) is easily constructed. Vector (CH) is parallel to (I) and at an angle of 30 degrees with (CD) and (HB) is 90 degrees ahead of (I) and 30 degrees out of phase with (DB).

If the angle CBD were less than 30 degrees compensation could not be obtained as here shown. However, it could be obtained by changing the current transformer from the (Y) to the (Z) leg and making another setting of the compensator. The current in (Z) reversed is 60 degrees ahead of (I_y) and 30 degrees ahead of the voltage represented by the vector CD. The compensator then is set at (R^{11}) and (X^{11}) to give the vector relations shown in Fig. 3 (d).

In this method of line drop compensation, the phase rotation in the three-phase line is to be considered. Suppose that the connections are as illustrated in Fig 3 (a) but that the phase rotation is reversed. This would correspond to interchanging any two phase letters in the diagram of Fig. 3 (b), for instance interchange (X) and (Y). The current in (Y) would then have the position occupied by (I_x) and the (YZ) voltage would have the phase relation represented by the position of the (XZ) vector in the diagram as it stands. The current in (Y) then would lead the (YZ) voltage by an angle of (30° — ϕ). The compensator current would therefore be 30 degrees ahead of (CD) or 30 degrees ahead of the imaginary current (I^1) of the vector diagram and the setting of Fig. 3 (d) would be required. If the current transformer were in (Z) and the potential taken off from (YZ) and the phase rotation reversed with respect to that shown in the diagram the setting required would be that of Fig. 3 (e).

The scheme of three-phase compensation illustrated in Fig. 4 cannot be used with the line drop compensator described above but may be carried out with the type illustrated in Fig. 5. This scheme was suggested by the writer and upon test it has been found to work out satisfactorily. The current transformer is placed in the leg which is not included in the phase off which the potential is taken. The connections of the reactance side of the compensator are reversed. The reactance side is set to give the proper value of voltage to compensate for the resistance drop in the line and the resistance side is set to compensate for the reactance of the line..

In the diagram showing the vector relations the current in (X) is seen to be 90 degrees ahead of (CD) which lags behind (YZ) by angle (ϕ). The voltage in the resistance side of the compensator will be in phase with the current while the reactance side, before reversing its connections, will give a voltage 90 degrees ahead of the current. These voltages may be represented by vectors (HF) and FB). Reversing the connections of the reactance coil of the compensator shown in Fig. 1, would not alter these vectors' relations as it would reverse the direction of voltage drop only with respect to the coil itself and not with respect to the rest of the circuit. In the compensator of Fig. 5 there

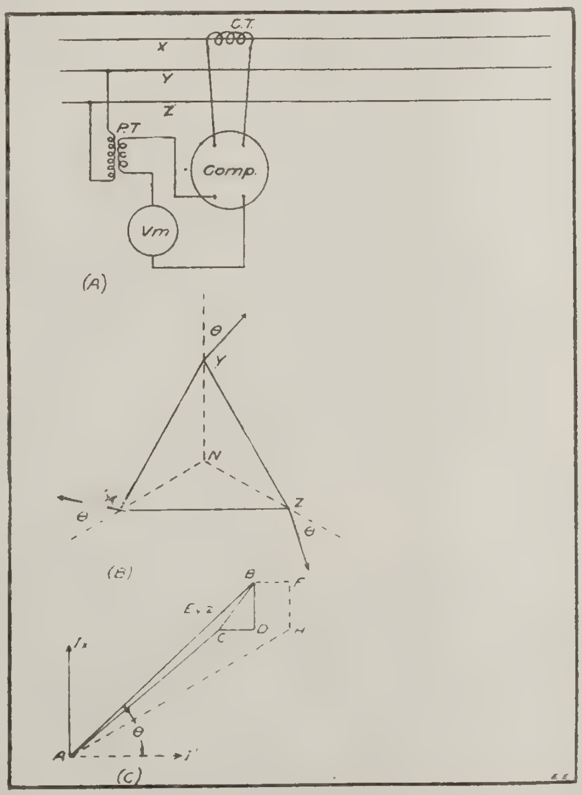


FIG. 4. A THIRD ARRANGEMENT OF COMPENSATOR ON A THREE-PHASE LINE.

are two transformers, one for resistance compensation and one for reactance compensation and so the voltage used to compensate for reactance drop may be reversed by reversing the connections of the secondary of the transformer supplying this voltage. In this way the phase relations of the diagram ABCD are obtained.

The compensator whose internal connections are shown in Fig. 5 differs in principle considerably from the more general type described above and merits some special consideration. It is of Westinghouse design and one of its transformers is shunted across the non-inductance resistance (R). The voltage across the primary and hence the voltages over the secondary taps also are in phase with the drop over the non-inductive resistance. The secondary voltages being in phase with the current, this part of the compensator may be used to compensate for (RI) drop in a line. The other transformer is in series in the circuit and there is no load on its secondary as it is used in the compensator. It gives voltage which is 90 degrees ahead of the current and is used to compensate for reactance. The sections included between adjacent taps numbered from one to five give five times the voltage between taps numbered from six to ten. Thus it is possible to obtain 25 different settings on either the ohmic or inductive side by varying the position of the contactors (AA) and (BB) which serve to close the circuit leaving in as many sections are desired. This compensator then has many more possible settings and is capable of a closer adjustment than the other type as ordinarily constructed. As the voltages obtained from the little transformers are proportional to the current taken by the compensator, the ohmic and inductive sides give the same effect as is obtained from the other type by voltage drop over resistance and reactance and curves for compensator settings may be made to a scale of equivalent ohms.

The relative merits of the compensator schemes described above may now be considered. None of them gives an exactly averaged compensation for the three different phases where there is an unbalanced load. However, the two current transformer scheme gives a better approximate average than a single current transformer scheme. Suppose that in Fig. 3 a single-phase load is added on the (XZ) phase to the balanced three-phase load, thus unbalancing the circuit. If this single-phase load has the same power factor as the balanced three-phase load, the currents in the (X) and (Z) legs will be increased without affecting the current in (Y) or the current in the compensator. In such a case it is readily seen that the compensator might

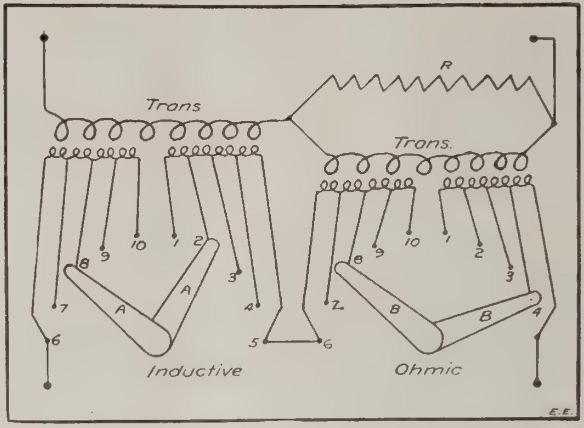


Fig. 5. Internal Connections of a Compensator.

give very far from averaged compensation. On the other hand in the two current transformer method an extra single-phase load placed on any one of the three-phases will affect the current in the compensator but the increase will in general be greater if the additional load is placed upon the phase in which there are two current transformers than if placed on either of the other phases. In the two current transformer scheme, the compensator current is $\sqrt{3}$ times as great as in either of the one current transformer schemes, also $\sqrt{3}$ times as great as if used on a single-phase line carrying the same current. Therefore a compensator of higher rating will be required, assuming current transformers of the same ratio in each case.

The single current transformer schemes have the advantage of requiring less expense for apparatus. The third scheme of compensation can not be used with the type of compensator illustrated in Fig. 1, while either type of compensator may be used with the other schemes. The third scheme requires a reversal of connections in the compensator which, however, can be very conveniently made, and the second scheme requires a little extra calculation for the special setting. The second scheme is complicated by the fact that direction of phase rotation enters into the problem. In the first and second schemes it is only necessary that the connections to the current and voltage sides of the compensator be of correct polarity and this is necessary in any compensator connection. In the second scheme usually one side of the compensator must be set to give nearly as large a voltage drop as the total required and so this scheme is more likely than the others to require a setting too high for the compensator.

Some Handy Tools for the Wireman

BY JAMES A. PERRY.

When a wireman has a great many fixtures to install, the quickest way of handling the job is to scrape and twist connections for possibly fifty of them, and then solder and tape them later. This procedure saves time, and hence, money. Furthermore, if the ladle method later described, is used, splotchs of solder on the floors can be avoided, and there will be no blackening of the ceilings that occurs when joints are soldered with a blow torch.

Note: This article is continued from the December 1914 issue.

The soldering of the fixture connections in a job like that above referred to can be most readily affected by using a small ladle such as that indicated in Figs. 20 and 21. Either of these ladles can be heated by the ordinary blow torch. In soldering, it is only necessary to dip the twisted and fluxed ends of the fixture conections into the little pot of molten solder, and then strike the connection a tap or two with the hand to knock off the surplus solder. The ladle of Fig. 20 is made by screwing a part of a steel armored cable bushing into a half-inch gas cap. This pro-

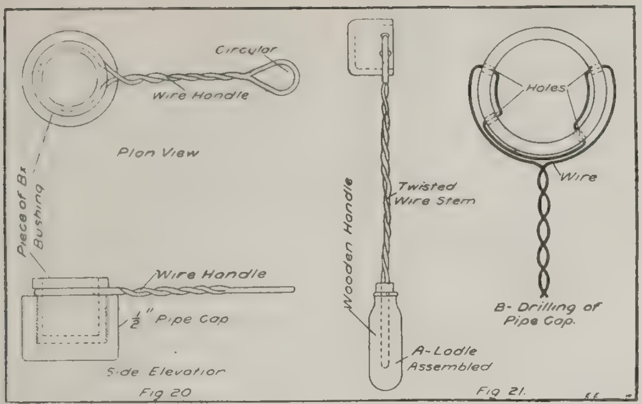


FIG. 20. LADLE FOR SOLDERING FIXTURE LEADS. FIG. 21. LONG HANDLE FOR LADLE.

vides a shoulder in which the wire of the handle can engage.

Another method of making a soldering ladle of a little larger capacity is shown in Fig. 21. In this, four holes are bored in a ½-inch or ¾-inch pipe cap, and the wire for the handle is threaded through them as shown. The cap cannot turn in the wires, hence, the threading provides a very substantial attachment. A wood handle (Fig. 21) will be found very convenient because if the handle is made of wire only, it is apt to become uncomfortably hot.

How to best carry his soldering paste is usually somewhat of a problem to the average wireman. It is supplied by the manufacturers in cylindrical tin or pasteboard containers, which are of rather inconvenient size to carry to the points where the soldering is being done. One scheme that has worked out very well in practice, is to transfer to a grease cup some of the paste and to use the grease cup in feeding it to the joint to be soldered. Fig. 22 shows grease cups of two types used for this purpose. In that of *A*, which is the cheaper, the paste is fed through the orifice by turning the top. A steel retarding spring which will fit into a groove at each revolution, prevents the cap from unscrewing easily. The grease cup at *B* is the most convenient because the paste can be fed either by a direct push on the feed plunger or by turning the feed handle. Furthermore, the valve screw provides a means whereby the cap can be entirely closed before it is placed in the wireman's kit for the night, or for transportation.

Another method of carrying paste that has been used by some wiremen is that shown in Fig. 23. In this, a small can to contain the paste can be directly attached to the blow torch by using a piece of a shade holder. This makes a very convenient arrangement for certain kinds of work. By loosening the set screw in the holder, the can is easily removed for re-filling.

Sometimes the electrician finds it necessary to re-slot commutators that were formerly slotted, but that have worn down, or to cut mica from those that were not, but which should have been, slotted by their manufacturers. For a make-shift arrangement, the mica can be scraped out with the edge of a hack saw blade, but a much better and more accurate tool is that shown in Fig. 24. It is forged from a piece of tool steel, and in use is held in the tool post of a lathe. The armature that carries the commutator to be slotted is maintained between the centers of the lathe. Then the slide rest with the tool described and its tool post, is worked backwards and forwards. Each time it goes forward, the tool should be set to cut some of the mica from between two commutator segments. The

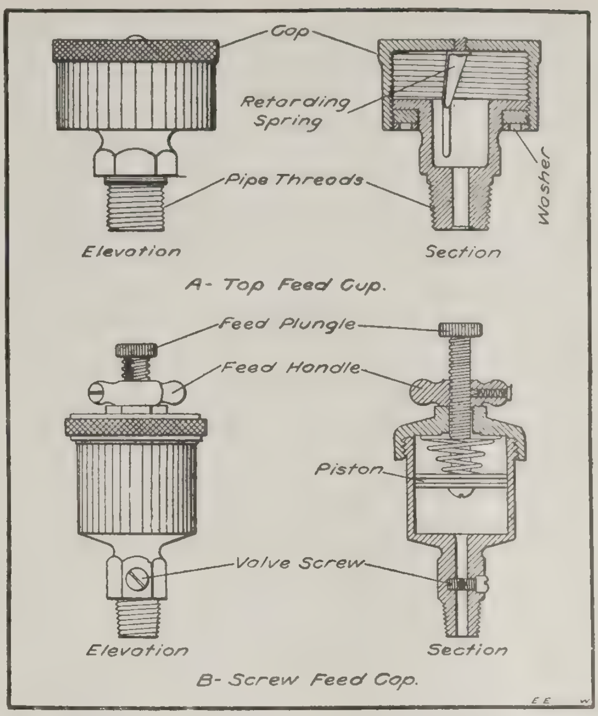


FIG. 22. GREASE CUPS FOR CARRYING SOLDERING PASTE.

action is in a general way similar to that of a planer or sharper. After one slot has been cut to a sufficient depth, the armature is rotated and the next one cut, and so on, until the entire armature has been re-slotted.

Screwdrivers especially designed for starting screws, that is to hold the screw in the end of the driver for insertion in inaccessible places, are regularly made by manufacturers. Their prices are very reasonable, hence if one requires a screw starter he will probably find it most economical to purchase the commercial article. However, if such for some reason or other is not available, he can make one for himself as shown in Fig. 25. The end of an old screw driver is cut off square as shown at *A*. A slot is sawed in the end. Into this slot, two pieces of clock spring, possibly 1 in. long by ¼-inch wide, are soldered. The pieces to be soldered should all be filed bright, and tinned with sal-ammoniac as a flux before they are inserted in the slot. After they have been thus prepared and inserted, additional solder should be sweated on. In using the tool, the two clock spring leaves are pressed together and inserted in the slot of the screw. When the pressure on them is released, they will grip the screw and hold it while it is being started.

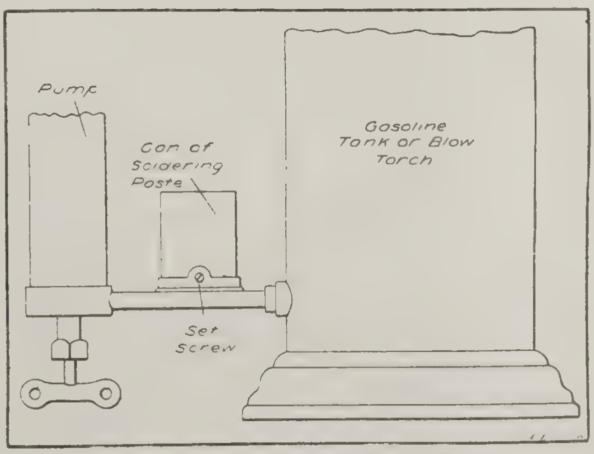


FIG. 23. PASTE CAN FOR BLOW TORCH.

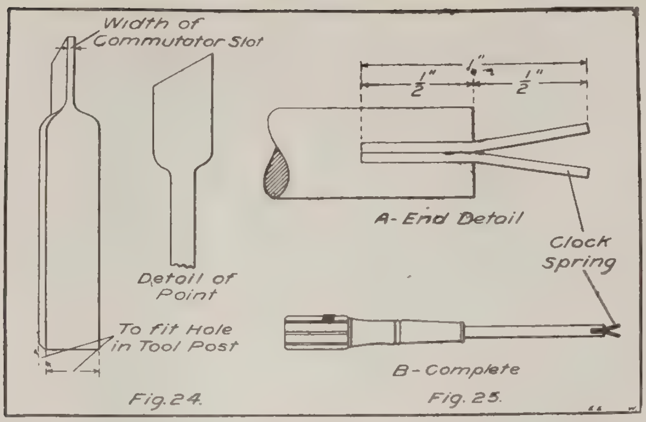


Fig. 24. Tool for Slotting Commutators. Fig. 25. Screw Holder for Screw Driver.

Every man that does much knob and tube work must have thought at some time or another of the time that is required to string leather heads, that is, to insert the nails in the leather washers that are used with porcelain knobs and cleats to prevent the breaking of the porcelain. Figs. 26 and 27 show a simple device whereby this threading can be accomplished quickly and with minimum labor. In a large shop the threading device should be installed in the stock room. Then the stock-boy can use his spare time in putting nails in the leather heads. When the nails are drawn out of stock for a job, the leather heads

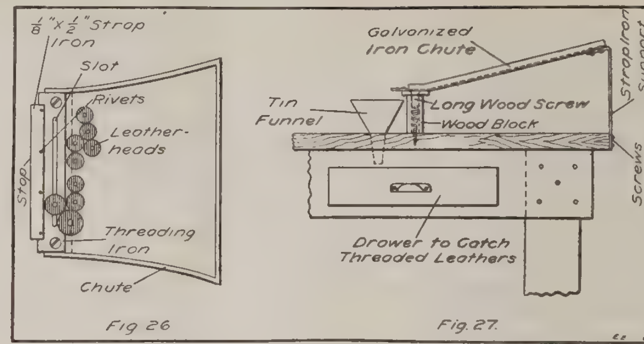


Fig. 26. Stringing Device for Leather Heads and Nails. Fig. 27. Mounted on a Bench.

will be in place on them, all ready for insertion in the knobs. The arrangement consists (Figs. 26 and 27) of a galvanized iron inclined chute into which a supply of leather heads is dumped. The heads slide down against a stop of 1/8 in. x 1/2 in. strap iron. When they are in this position, the holes in the heads lie directly over a slot in the threading iron, and a nail is driven into each leather head and into the slot. Then the nail and the leather head are taken up and dropped through the funnel into the drawer prepared for their reception. The constant pounding causes the heads to continuously slide down the chute, hence, as soon as a nail is driven into one head and it is removed, another head slides down to take its place.

Some Problems Met and Solved by an Electrical Troubleman

BY J. A. HORTON.

Feeder and Transformer Troubles.

The operation of electrical equipment may be continuous as in the case of a lighting generator or motor driving shop shafting. It may also be intermittent as in the case of motor driving a crane, elevator or other machine whose duty may be composed of alternate periods of work and of rest. The generator or motor is rated higher for intermittent than for continuous duty because the rest periods give it a chance to cool, the temperature rise generally being the limiting feature upon which the ratings are based. It is thus obviously unwise to operate any machine continuously at its intermittent rating. So insistent are manufacturers in regard to this condition, that many of the name plates include both the continuous and intermittent ratings.

An operator once installed a feeder voltage regulator that was supplied under the specification that it would not be required to operate more than from 8 to 10 times per minute. Under the load conditions existing at the time of installing this was a safe proposition as proven by the fact that the unit operated satisfactorily for several years. In course of time, however, the motor of the regulator began to heat excessively and finally it burned out. It was rewound but after a few months, burned out again. In each case examination of the starter showed its insulation to be well charred. The motor was repaired again, but the operator had made up his mind to get another regulator and as he did not see any sense in getting one similar to the original, he called on the manufacturer's representative to advise him. An engineer ascertained that the regulator was operating from 20 to 40 times per minute. The increase in the frequency of operation was due to the gradual change from an almost straight lighting load to a mixed load of which induction motors constituted the greater part. With the lighting load the voltage changes were small, few and comparatively far apart in point of time. The more frequent and more violent changes incident to the startings and stoppings of the induction motors, therefore, gave to the regulator motor a duty that approached continuous duty and the motor could not stand the abuse. The situation was relieved by the installing of a regulator that was equipped with a larger motor.

Why Feeder Fuses Blew.

On a separately excited, direct current, belt driven, generator, the driving speed variations produce proportional variations in the generator e.m.f. because the generator field is independent of its e.m.f. On a self-excited similar unit, a given speed increase, for example, will produce more than proportional e.m.f. increase, because an increased e.m.f. is then applied to the field terminals, thereby increasing the field strength, so that the armature rotates at increased speed in a field of increased strength. If the direct current machine is used as exciter for an alternator that is subjected to the speed variations of the same prime mover, water wheel or engine as the case may be, the e.m.f. varia-

tions of the alternator will be further intensified, because they will be affected not only by the speed variations of the alternator itself, but also by the alternator field strength variations incident to variations of the exciter e.m.f. As all of these variations will have the same sign, it may be appreciated that prime mover speed variations of such a set will be multiplied when expressed in terms of variation of the alternator voltage.

The motors and lights of a large mill were operated from a water wheel driven generator excited by a machine driven from the same wheel. For a long time after installing the machines. operation had been entirely satisfactory. After a while, however, the fuses of the feeders leading to the several parts of the plant, began to blow at such close intervals as to seriously interfere with plant production. As usual in any case involving electrical apparatus, the electrical apparatus was blamed, but thorough inspection failed to disclose any electrical irregularity. Finally it was noted that the surgings of the switchboard instruments were more violent than had ever been noted before. Tightening of all belts did no good and careful inspection showed no hot bearings. With the water wheel governor cut out, however, all surging ceased.

The trouble proved to be due to the fact that the pump used to draw the oil from the dead side of the pilot valve for return to the oil reservoir, was not functioning properly because of impaired vacuum incident to a leaky packing This caused the governor to overrun, thereby causing abnormal speed variations, hence voltage variations. This in conjunction with starting heavy motors, produced the heavy current rushes that blew the feeder fuses. Overhauling of the vacuum pump eliminated all trouble. It seems that the governor had never given the least trouble from the day that it was installed, which justified the opinion that it was above suspicion, because trouble and experience go hand in hand.

Transformer Impedances.

The reactance of a constant potential transformer operating with open secondary is due to the self inductance of the unopposed primary coil. With a closed secondary, the reactance or choking effect of the transformer, depends upon what proportion of the lines of force due to each coil is enclosed by the other coil. In other words, in order to reduce a loaded transformer to the condition of a resistance without reactance, it would be necessary that all of the magnetic lines of force in the core cut all of the turns of both primary and secondary coils. If the primary and secondary coils of a transformer be located at opposite ends of a long core, many of the lines due to each coil will turn back before reaching the other coil. Under this condition there would be comparatively little neutralization of primary lines and the reactance would be high. The moving of the two coils closer together would reduce the leakage between them and thereby reduce the reactance by improving the conditions of neutralization.

In actual transformer construction this idea of bringing the coils more intimately together, is carried out further by winding both the primary coils and secondary coils in sections and alternating the sections when assembling them upon the core, so that every primary section has a secondary section alongside of it. By variations in the manner of interspacing the coils, the reactance, hence impedance, of a transformer can be controlled within reasonable limits. It follows, then, that the impedance of a transformer will depend largely upon the manner in which the coils are assembled.

To illustrate, an operator who was using a 100 Kw. single-phase transformer, had a load increase that required more transformer capacity, accordingly, he bought another unit of the same rating and from the same makers but failed to specify that the new transformer had to parallel with the older one. The result was that he got one of improved coil assembly and it would not share the load proportionately with the one of older method of assembly, when the two were paralleled on the secondary side. To make them parallel satisfactorily, it was necessary to insert external reactance in series with the unit of lower reactance. There was no objection to this, except in the looks, because a given reactance increase would have the same effect from the point of view of economy, whether the increase were included in the design of the transformer or whether it were included in an external coil.

Why Transformer Was Off Ratio.

Ordinarily the indicating error of a well designed potential transformer is negligible unless the transformer has a defect or is overloaded, but as in the case of all other devices, it cannot be expected to thrive under abusive conditions. An operator once complained that one of his potential transformers (of which type he had several) was five volts off ratio, as compared with other transformers in the same service. He requested a local electrician to find his trouble. By interchanging connections with instruments and another transformer known to be alright, the operator's contention was proved to be right. The electrician disassembled the defective transformer to investigate its internal condition and noted that it had been recently disassembled. He made inquiry and learned unbeknown to the superintendent, who had sent for him, that a switchboard short-circuit had occurred some time before in which two potential transformers were involved. Both transformers had been injured to an extent that made them useless. As one of them was very badly needed and as the station was a long way from any shipping point, the local attendant, who deserved credit for his efforts had disassembled both transformers and had reclaimed a sufficient number of good coils to equip one transformer and get it on the line. This procedure would ordinarily have been very satisfactory but it so happened that each transformer included two kinds of coils. There was no difference in them so far as the eye could tell, but one kind had more turns than the other kind. He had included coils of both kinds but luck was against him and he had the wrong number of each. Substitution of two coils of correct specifications, restored the transformer to normal.

San Diego (Cal.) Exposition Opened January 1st.

The Panama-California Exposition at San Diego, California, opened at midnight December 31st with the pressing of a button in Washington, D. C., which turned on the special illumination that has been installed for the year. Arrangements made by the San Diego Consolidated Gas & Electric Company, a Byllesby company, were complete and all lighting and power requirements of the exposition are being served by the company under special contract.

Installation, Operation and Maintenance

This section is devoted to practical suggestions, experience and data, and is open to all readers who have something to say on every day work and trouble in the plant or sub-station, on the line, in the factory, mill or elsewhere.

Comments on Proposed Concentric Wiring System.

Editor Electrical Engineering:

A series of patents granted March 6, 1900, which have been examined by the writer seem to cover through broad claims, all the essential points of a grounded system of distribution for underground, overhead, series lighting, and alternating current light and power circuits in which one wire may be eliminated and the metallic covering of a conductor used instead. This is essentially what is meant by the "concentric" wiring system now being discussed by the trade. As compared with the so-called system of "concentric" wiring in vogue throughout England and used in cheap installations for a small consumer, the systems seem identical, as one lead in both cases is eliminated and the outer wire or casing, as the case may be, is used as a grounded return wire.

The general use in England of the concentric system for interior electric circuits was brought about mainly by the introduction of the tungsten lamp. The change to the high-efficiency metal filament lamp considerably reduced the current consumption for any given lighting equipment and similarly lowered the cost of lighting by electricity. The advantages of electric light over any other light source is even recognized in the most humble home, and with the advent of cheap lighting, the demand for same had to be met by the introduction of a relatively low-priced wiring system. The two, combined, meant not only satisfaction to the customer but increased revenue to the electric service company and the allied trades.

Electric systems for varying services, are almost universally controlled to a certain degree by local rules and restrictions, and it is only with the co-operation of the authorities having jurisdiction that the introduction of a new system may be made a reality. In England, the success of the venture becomes more marked every year by the increasing number of small lighting customers. An examination of the foreign rules and regulations will show that they are not literally strict but they do insist on a first class installation.

Since the writer is familiar with the British systems, he will endeavor to describe same. Disregarding the system of charges or rate schedule used by the different companies in handling the small consumer, as this is the nature of load requiring cheap wiring systems in order to use electric light, we will endeavor to consider the installations proper, for the companies' service is a subject that should be treated separately.

Light-walled iron conduit and wood-molding has been and still is used extensively, but these methods are too high-priced to meet the demands for inexpensive lighting circuit installations among the people of small means who desire to use electricity as a light medium. This brought about the introduction of several schemes for cheap "surface" wiring. The term "surface" wiring denotes all exposed installations and wiring merely buried in the plaster. As these wiring systems are used extensively in existing houses and it keeps the cost of installation down to a minimum. If occasion demands it, the wires may be easily buried in the plaster, as the size of wiring unit, required for an ordinary lighting circuit is even less than ¼ inch in diameter overall. The exposed wiring system seems to be quite popular, because the system is not unsightly and may be readily run so as not to be conspicuous. It is also an easy matter to finish the surface to match any surrounding decorations.

Properly speaking "concentric" wire refers to cables having an inner conductor well insulated on the outside, and over this insulation a similar cross-sectional area is obtained by placing concentric wires around the insulation. These latter wires may or may not be insulated. The so-called "concentric" system as applied to house lighting systems seems to derive its name from the cable on account of the similar functions of the outer metallic casing or conduit which is also used as a return conductor. But concentric wiring is not the only inexpensive system.

A line of "Kalkos" tubing or conduit with necessary fittings, and "Stannos" wire as made by Siemans Bros. & Co., seems to be the most popular form of wiring for existing buildings. The Kalkos conduits are made of light gauge tinned brass with open joints. These joints are made tight during erection by soldering thereby insuring electrical continuity and water-tightness. One copper wire of any standard manufacture is drawn in and electrically bonded to the conduit which is in turn properly grounded, and acts as a return wire.

The Stannos wire is an electrical conductor, tinned, having a thorough insulation and taped. It is then encased in a thin copper sheathing or conduit which is made tight and electrically continuous. This outer casing is applied in such unique manner, that the resultant product is a mechanically protected wire with a good degree of flexibility. The sheathing being used as a grounded return, the size of the wire complete is quite small and therefore makes a neat and unconspicuous installation.

Systems using two wires or twin conductors, are similar to wire manufactured in this country and used here under varying conditions. In England, however, the following are permissible for interior house wiring: flexible armored conductors; fire-proof wire; and cotton covered leads. The armored conductor consists of two wires, rubber and cotton-covered and formed into circular shape. This, in turn is covered by tinned iron wire or straps leaving the whole flexible. The fire-proof wiring is also a twin conductor circular in shape, thoroughly insulated and then weather-proofed; the whole is then covered with fire-proof material, but not asbestos. The cotton covered wire is similar to the fire-proof conductor but the outer covering is of cotton.

The concentric wiring systems require special fittings and accessories for cheap installation and also to secure an electrical bond or continuity, whereas the twin conductors require only a limited amount of special accessories.

As to the use of any such systems in this country, the main obstacle is of course the National Board of Fire Underwriters. To this may be added the local Board of any locality which may have jurisdiction. It is a recognized fact that the above mentioned authorities have interfered with the development along the above named and similar lines and thereby have caused a considerable loss to the central station interests in this country, besides encroaching on the possible comforts of the public that may have otherwise been realized. The owners of buildings feel this to quite an extent financially, for on account of the stringent rules of these Boards, the cost of electrical installations have been considerably increased.

Fire insurance authorities point to the homes across the ocean as models to be followed for prevention of losses due to fire. Then it seems to me it is certainly inconsistent on their part to be so far behind in electrical matters, simply on account of an imaginary fire hazard.

Taking the instance of England again, and even disregarding the "surface" systems outlined, their rules allow the use of a wire as small as 2300 circular mils in area for a current of 7.2 amperes for circuit wiring, whereas our rules call for a wire of not smaller than No. 14 B & S gage or over 4100 circular mils in area. Even though this size is rated for a safe current capacity of 15 amperes, we are compelled to use it in ordinary house circuits, which at 110 volts supply do not exceed 6 amperes.

Then again, for conduit systems, our authorities require a pipe not less than ½ inch trade size and of relatively heavy weight, whereas the English concentric wires have a sheathing close to the insulation, thus allowing a light gage conduit of less than ¼ inch diameter for a common lighting circuit.

The advantages claimed for the concentric wiring systems by its advocates, are mainly cheap first cost for installation. This, of course, would permit the central stations to increase their business considerably by reaching even into the poorest of residences or apartments, and the load to be gained thereby is a matter that cannot much longer be slighted.

It is only natural that the manufacturers of fittings and lighting accessories should at first oppose any such movement but after being given the opportunity to adjust their plants for the new accessories, their business would certainly be increased for it is not expected that any concentric or other surface wiring systems would, in any way interfere with modern electrical construction. These new changes would merely be a happy outcome for the central station, electrical workers and manufacturers, and the small consumer, as it would mean the wiring of many existing buildings, thus the use of accessories, the supply of current and the comforts of electricity in the home.

As to the first cost of the wire proper including the sheathing, it is doubtful whether the concentric system will be any cheaper than a twin conductor, but of course, the methods of installation would eventually become relatively low because the electricians will have learned the art of installing such systems.

The writer believes, however, that an armored or fireproof twin conductor might be more desirable as electrical workers would not have much to learn in installing systems using this form of wiring, and no doubt the total cost would be much less, as few special fittings would be required. Where in twin-wire systems, double-pole switches would be used, unless single pole switches be allowed by the Underwriters, the difference in cost of same would really more than counterbalance the special fittings and appliances necessary for making a continuous electrical bond in a grounded concentric system.

It is therefore up to those concerned, in the electrical industry, to impress the Underwriters that No. 16 B & S gage wire of 2583 circular mils in area and even now rated at 6 amperes carrying capacity, is large enough to transmit the current required for a common house lighting circuit. Of course, smaller size conduit and of lighter gage would also have to be permitted for concentric systems. Taking No. 16 B & S gage wire as a basis and allowing 1/32 inch good rubber insulation with one wire in a light walled conduit, then the over-all diameter would be a little more than ⅛ inch. And for twin-conductors constructed along the same lines the over-all dimensions would be less than ¼ inch. Such combinations would surely be workable and on account of the small sizes would not be unsightly even if run exposed. Consulting Engineer, New York City.

Operating Features of High Speed Resistance Type Outdoor Lightning Arresters.

The need of an effective weather-proof lightning arrester for high capacity outdoor sub-stations has resulted in a great deal of research by high tension specialists, and many forms of equipment have been proposed. The fundamental objection to the older forms of arresters is that they require frequent, or in some cases daily, inspection, attendance, and adjustment. The initial cost is comparatively high, the upkeep considerable, and in general the arrester is too delicate and complicated to meet conditions imposed by outdoor sub-station service.

An important qualification of a high-capacity lightning arrester is a low resistance "straight line" path to ground. The amount of resistance in an arrester ground circuit largely determines its effectiveness—the ideal arrester being one having no serious resistance to impede the high frequency discharge. A static or lightning disturbance will, or will not, be drained from the system, just in the proportion that the arrester resistance permits charges to escape more or less rapidly than they reach the arrester.

With high series resistance in the ground circuit, comparatively high potentials may still exist on the system, even while the arrester is discharging. With low, or no resistance in the ground circuit, high potential charges cannot be maintained at a dangerous value. A "straight series" resistance in the ground circuit, sufficiently high to be of any real value in limiting current flow, impedes the freedom of static discharge. With a low straight series resistance, the arrester will discharge more freely—but the current flow to ground will be increased. Operating conditions of high-capacity outdoor sub-stations, therefore, demand a "straight line" lightning discharge path and a high resistance path for limiting dynamic or line current.

An entirely new type of arrester which embodies these features is shown diagramatically in Fig. 1, while Fig. 2 shows a standard outdoor sub-station unit, consisting of

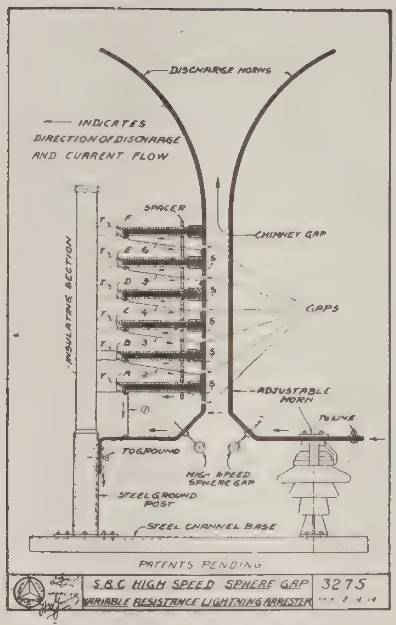


Fig. 1. Arrangement and Connections for High Speed Sphere Gap Resistance Lightning Arrester.

A=No. 1	Resistance	1=Ground Lead	
B=No. 2	"	2=Connects	A & B
C=No. 3	"	3= "	B & C
D=No. 4	"	4= "	C & D
E=No. 5	"	5= "	D & E
F=No. 6	"	6= "	E & F

T indicates insulating tubes and S indicates copper segments.

a switch, fuse, choke coil and sphere gap arrester. Referring to Fig. 1, it will be seen that the arrester element consists of two discharge horns, one of which is solid, insulated and adjustable. The other is sectionalized and fixed in position. The lower section of the fixed horn is mounted on a steel ground post, an insulating section supporting tubes containing non-inductive resistance. To the outer ends of the insulating tubes and resistances are secured copper segments of the discharge horn—a small air gap being left between each segment. The resistances are connected in series, and the steps graded in value.

Lightning and static disturbances of high frequency are rapidly discharged across the "high-speed sphere gap." This gap having no series resistance furnishes an ideally free discharge path to earth, rapidly draining any static. Under abnormal static conditions, the incoming surge breaks across the straight line gap to ground—no resistance being in circuit. If the discharge is followed by line current the arc rises rapidly, due to the heated gases, the chimney-shaped gap increasing the rate of travel.

As the arc travels upward, passing from segment to segment, it automatically introduces resistance in series with the ground circuit, materially reducing the current flow. This resistance, increasing in value as the arc rises, insures a comparatively small arc quickly suppressed on the diverging horns. Between the load and the incoming surge is located a powerful, specially formed choke coil, which reflects surges to the arrester.

From Figs. 1 and 2, it will be seen that lightning has a "straight line" path to earth, there being no resistance between the lower section of the sectionalized horn and

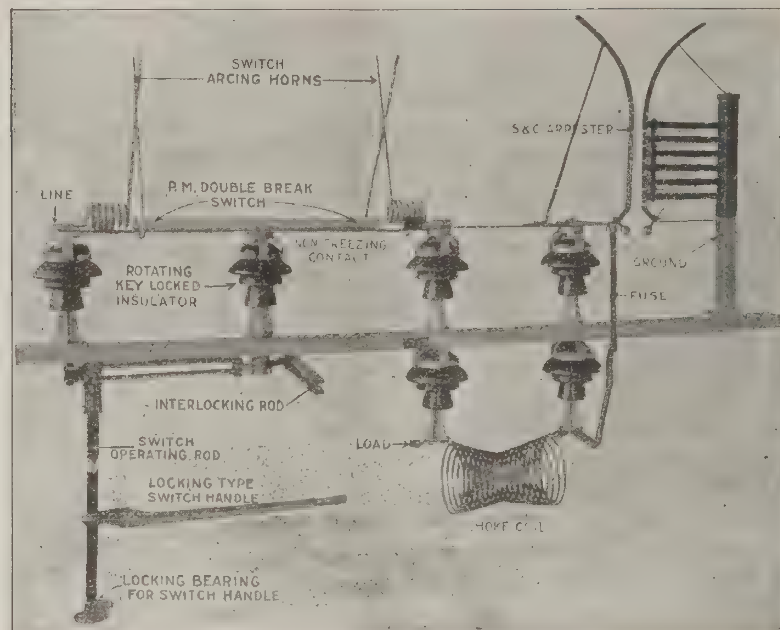


Fig. 2. Complete Outdoor Substation Lines of 100 to 2000 Kw. Capacity for 13,200 to 66,000 Volts.

ground. The resistance comes into circuit only as the arc rises and thus performs its proper function—namely, to automatically limit the current flow and resultant arc.

Outdoor high-capacity sub-stations can now be installed at remote points as the arresters do not require daily charging, have no electrolyte to heat or freeze; film aging is eliminated; the discharge rate is high; there is no "straight series" resistance, the limit resistance can be established at any desired value with frequent attendance, adjustments, or inspections unnecessary. H. W. Young.

Connections for a Two-Phase-Three Phase generator.

It sometimes happens that the owner of a two-phase generator is called upon to furnish power to a three-phase motor. The question then arises, how can the existing two-phase machine be arranged to give three-phase current?

Probably the easiest way for so doing, where the voltage desired is other than the generator voltage, is by means of two transformers, Scott connected. This arrangement is familiar to most operating engineers, and can be found in any electrical handbook. It may happen that the voltage is already low, therefore not requiring transformers.

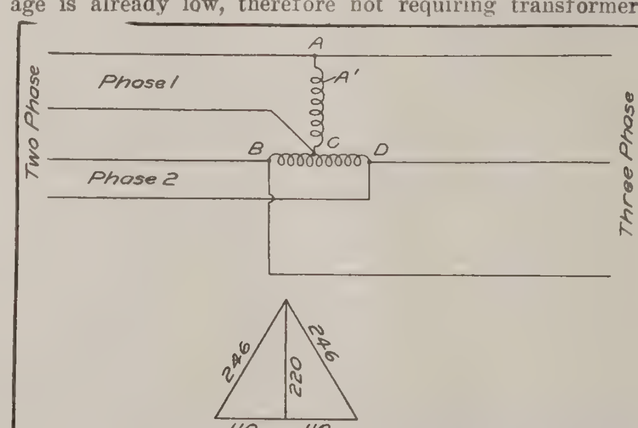


Fig. 1. Connections for 2-Phase Machine to Secure 3-Phase Supply.

That is, it may be that the generator delivers voltage at two-phase which is about the same as that required at three-phase. In this case, the engineer would not wish to go to the expense of transformers if the three-phase relation could be obtained without it. In this case he can connect as shown in Fig. 1.

As seen from the voltage triangle, the three-phase voltages will not be balanced, for one will be 220 and the other two each 246. However, if a motor is the only load to be served, this would not make a serious difference except to increase the losses in the motor. From the diagram, it is seen that it is necessary to find the mid-point in one of the two-phase windings. This will not be easy to do, yet it can be done by carefully counting the coils.

Another slip ring must be put on the generator shaft. If six slip rings were available so that the tap marked A_1 could be used instead of A^1 for the three-phase side, and this tap were brought out at 87 per cent of the whole winding, perfect three-phase relations could be obtained.

This system is not to be recommended as it inter-connects the two phases. This may cause operating difficulties to such an extent as to render it advisable to make the added investment necessary for two Scott transformers.

Prof. G. B. McNair, Kansas State College.

Cost of Privately Generated Power vs. Purchased Central Station Current.

Some time ago, Mr. G. T. B. used these columns for a problem almost identical to the one numbered 484 on page 425 of the October issue. The private or "isolated" steam-electric power plants are both apparently of the same capacity and compete with a local central station. It is possible that under some conditions these plants might prove a better proposition in another city where the charges for central station current are very high, but not so when electricity may be purchased from a public source at such equitable rates as shown in the following schedule.

FIXED MONTHLY CHARGE.

First 10 Kw. of demand ....@ \$3.50 per Kw.
Next 40 Kw. of demand ....@ 2.50 per Kw.
Over 50 Kw. of demand ....@ 2.00 per Kw.

CHARGE FOR CURRENT CONSUMPTION.

First 500 Kw.-hrs. ....@ 4.5 cents per Kw.-hr.
Next 45,00 Kw.-hrs. ....@ 2.5 cents per Kw.-hr.
Next 45,000 Kw.-hrs. ....@ 1.0 cents per Kw.-hr.
Over 50,000 Kw.-hrs. ....@ 0.9 cents per Kw.-hr.

Instead of submitting actual information to enable one to even estimate the probable costs of power generated by the isolated plant for comparison with the purchased central station current, Mr. G. T. B. asks that this data be assumed. Such practice should be guarded against for it necessitates considerable figuring based on assumptions and the results therefere may not do justice to the actual requirements as known to exist.

There are no hard and fast rules for solving engineering problems of this nature, so that in order to estimate the cost of power one must rely entirely on experience and have a thorough knowledge of the conditions to be considered. As these qualities vary with individuals, then the charges which are taken into consideration will of course also vary, not only in extent but in vlaue. Even though actual figures of operation are available and the power costs determined by the accounting department, the chief engineer will usually argue that the charges were not justly distributed and that the electrical department has been subject to excessive overhead charges. Differences of opinion will no doubt continue for quite a time on this all-important question of comparative power costs, especially as no standard system of accounting is in vogue.

A form that has been recommended to central station engineers for use in recording isolated plant operating costs for comparison with purchased power, is reproduced and shown herewith as Fig. 1. By using the items listed on this account card, and making proportionate deductions for expenditures chargeable to departments other than for the production of electric current, the net power cost or manufacturing expenses of the private plant may then be compared with cost of power purchased from the public service company. In order to determine the relative advantages in privately manufactured electricity as against purchasing current from a public source, the isolated plant will be favored with a good degree of economy and efficient operation.

It is assumed that the plant is housed in a building used for light manufacturing purposes, supplying an almost constant load during the usual working period. There are two steam engine-driven direct current generators, one of 200 Kw. capacity and the other 75 Kw., with no spare units to handle even a part of the load in case of a break-down. There is no outside "break-down" service provided for emergency because the central station supplies alternating current, which is not suitable for driving the present equipment.

POWER ACCOUNT

ITEMS CHARGEABLE TO ISOLATED PLANTS.

OPERATING EXPENSES	Isolated Plant Cost		Cost with Central Station Service	
*Superintendence				
Wages....Engineers and....Engine Attendants				
Wages....Firemen and... Coal Passers				
Fuel, ...tons @..... .....per ton				
Car Demurrage				
10% shrinkage in Fuel, account of weather and transportation from mines				
Cost of Removing Ashes				
Water for Boiler......Gals @......per M gal.				
Cost of Boiler Compound				
Repairs to Engines				
Repairs to Boilers				
Maintenance and Cleaning of Boilers				
Repairs to Dynamos				
Maintenance & Repair Costs on D. C. Motors				
Repairs and Maintenance of Belts				
Repairs to Steam Elevators				
Repairs to Hydraulic Elevators				
Repairs to Electric Elevators				
Repairs to Steam or air lift pumps and Miscellaneous Machinery				
Cost of Changes in Piping, Pipe Supplies etc.				
Tool Account				
Incandescent Lamp Renewals				
Arc Lamp Carbons				
Arc Lamp Globes				
Arc Lamp Repairs				
Miscellaneous Expense, Oil, Waste, Packing, etc				
Cost of Break-down Service Purchased				
Value of Time Lost Account Failure of Isolated Plant Power				
Cost...............K. W. Hours C. S. Service				
TOTAL ACCOUNT, Operating Expenses				
FIXED CHARGES				
Interest on Power Plant Investment at 5%				
Depreciation on Plant Investment at 8% Motors 5%				
Ins. and Taxes on Power Plant and Bldg. 2% of Valuation, \$				
Rental Value and Space Occupied by Plant				
Decreased Rental Value of Space Made Less Desirable by Heat of Plant in Summer, and Vibration				
Risk of Damage to Employes and Public through Accidents and Boiler Explosions				
TOTAL ACCOUNT, Fixed Charges				
TOTAL COST For Maintaining Plant for..........................Months.	TOTAL		TOTAL	
TOTAL SAVING BY PURCHASING CENTRAL STATION POWER			SAVING	

*By "Superintendence" we mean the time of the head of the firm, or his principal assistant - high priced men—who look after the purchases for the plant, watch its economy and in many other ways devote time to it. If relieved of these duties, their time would earn you in other directions a large return

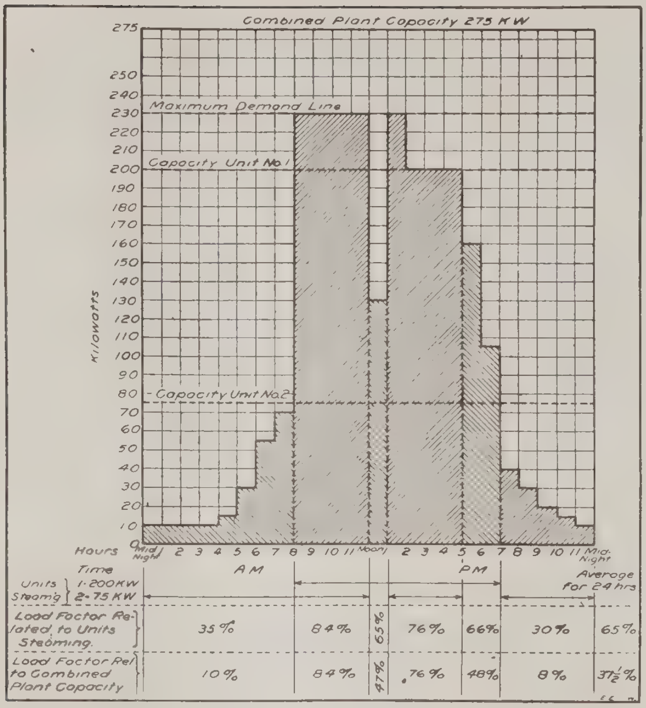


Fig. 2. Probable Load Curve for Plant.

There are three coal-fired steam boilers each of 200 horsepower capacity, with the necessary piping and auxiliaries. The coal, delivered at the plant costs $3.00 a ton and the water, being taken from a river, is equivalent to the cost of pumping it. The building is of such proportions that the available exhaust from the non-condensing engines can be adequately utilized for heat and hot water. The total first cost of this plant installed is estimated at $40,000.

Under such conditions of capacity, and almost continuous load, the maximum demand is 230 Kw., and the aggregate use of current for the year may be divided into a monthly consumption of 62,700 kilowatt hours. The load curve probably takes the shape shown in the diagram, Fig. 2, this being a representative day. It will be seen therefore, that the load factor is exceptionally high with respect to the generator units in actual operation during the different periods of the day, showing an average of 65 per cent. The load factor for twenty-four hours related to the total investment or the full capacity of the plant amounts to 37½ per cent.

The results of a study of the operating conditions as outlined above, and allowing the equivalent of seven men the whole year around as a force to properly manage the equipment, the following is the estimated cost of operation.

COST OF OPERATION WITH ISOLATED PLANT.

Account	Total Cost Steam and Electric	Costs Chargeable to Electric Current Production
Attendance	$ 6780	$ 4750
Fuel	9030	6500
Ash Removal	300	200
Water Pumping	525	400
Oil and Waste	560	400
Other Supplies	1615	1130
Repairs	1180	830
Fixed Charges	6000	4200
Totals	$25990	$18410

This data would indicate that the current may be manufactured on the premises at a cost of a little more than 2.4 cents per kilowatt hour.

In order to consider central station service as a possible means for carrying the electric load, a rotary converter must be installed to supply direct current. As the consumer must stand all the losses due to the transformation of the A. C. supply to D. C., the demand will be increased to about 252 Kw. and the monthly consumption would also be increased to about 73,000 kilowatt hours. This would make a monthly electric bill for the purchased supply as follows:

Fixed charge	
10 K.W. @ $3.50	$ 35.00
40 K.W. @ 2.50	100.00
202 K.W. @ 2.00	404.00
	$539.00
Current Charge	
500 K.W hr. at 4.5 cents	$ 22.50
4500 K.W. hr. at 2.5 cents	112.50
45000 K.W hr. at 1.0 cents	450.00
23000 K.W. hr. at 0.9 cents	207.00
	$ 792.00
Total Bill	$1331.00

The total charges for operating the steam equipment only, and purchasing current are therefore as shown below, allowing the equivalent of four men the whole year around as a force for the proper operation of the equipment.

COST OF OPERATION WITH CENTRAL STATION SERVICE.

Account	Total Cost Steam and Electric	Cost Chargeable to Purchased Current
Attendance	$ 3180	$ 1140
Fuel	1620	
Ash Removal	80	
Water Pumping	100	
Mis. Supplies	80	11
Repairs	70	9
Purchased Current	15975	15975
Fixed Charges	1500	
Totals	$22605	$17135

This data would indicate that current can be purchased from the central station at a rate slightly lower than 2 cents, or at a saving of 16⅔ per cent over the current generated by the isolated plant.

The above figures do not include any charges for the distribution system, but cover only such items that compose the cost of power production. It will be seen that with the isolated plant the total annual cost is $25990 for steam and electric services, as against a total cost of similar serivces of $22605 when purchasing current from a public source, this being a saving of $3385 a year. Thus the investment necessary for a complete rotary converter installation would show a return of about 67 per cent, and would therefore more than pay for itself during the first two years of service.

M. William Ehrlich, Consulting Engineer, New York.

Questions and Answers from Readers

Readers are invited to make liberal use of this department for discussing questions, obtaining information, opinions or experiences from other readers. Discussions and criticisms on answers to questions are solicited. However, editors are not responsible for correctness of statements of opinion or fact in discussions. All published answers and discussions are paid for.

Locating Blown Potential Transformer Fuses.

Editor Electrical Engineering:

(503) Please request readers of Electrical Engineering to give a fast method for locating a blown potential transformer fuse in a station where a number of potential connections are made to watthour meters. At present every time a fuse blows the watthour meters stop and the operator starts on a hunt for the blown fuse. During the time it is being located by testing all the fuses until the right one is found, the watthour meter readings are lost and an error creeps into the station records. When this happens often this error is considerable. How can it be prevented? W. A. S.

Winding Data for a Wagner or Century Induction Motor.

Editor Electrical Engineering:

(504) The writer would like to secure the winding data for a 2 horsepower Wagner or Century single phase induction motor having 4 poles, for operation on 110 volts, 60 cycles. A. H. A.

Direct Connected vs. Belted Generators.

Editor Electrical Engineering:

(505) Please give the engineering arguments in favor of a direct connected over a belted generator. What is the approximate saving in efficiency due to the direct connection? In case a gas engine is used as prime mover does the direct connection make possible more steady generator operation? T. M. S.

Why Do Disconnecting Switches Open on Shirt Circuits?

Editor Electrical Engineering:

(506) During short circuits the disconnecting switches in our station are often thrown open and on one occasion when this did not happen the bus structure was terribly bent. What causes this and how can the trouble be prevented? H. R. W.

Surveyed Head vs. Effective Head.

Editor Electrical Engineering:

(507) In connection with a water power station, what is meant by surveyed head and effective head on the water wheels? Also what is meant by static and running heads? On which of these heads are water wheels rated?

W. J. R..

Methods for Demagnetizing a Watch.

Editor Electrical Engineering:

The writer would like to secure information on how to quickly demagnetize a watch. We have a 250 volt D. C. motor equipped with slip rings to get an alternating current, but instead of demagnetising the watch when placed in its field, it increases the magnetism. What is the reason for this? H. F. K.

Why Commutator Becomes Black. Ans. Ques. No. 494.

Editor Electrical Engineering:

The probable reason for the commutator mentioned by Geo. M. becoming black is that it is uneven and needs turning down. This blackening can also be caused by unequal brush tension causing one set of the brushes to carry more than its share of the load and this set flashing every time it leaves a high spot on the commutator.

The machine is probably a four or six pole generator and a heavy short at some time probably caused the brushes to flash severely and eat spots on the commutator at the four or six equal points. The trouble can also be caused by mica being a little higher or harder in spots on the commutator. If spots still appear after a good stoning the tension on the brushes must be increased or even under cutting resorted to. If copper covered brushes are used, see that the copper coating is cut back from the point of contact on the commutator. If copper comes in contact with the commutator, rushes of current may be accompanied with flashing and produce a kind of sooty deposit on the commutator.

The writer has had some trouble of this sort himself. During a recent storm, water leaked through the roof and dropped directly on the commutator of a six pole, 500 ampere railway set while running. I tripped the machine out and pulled the field switch before damage could be done to the winding although severe flashing resulted. From that time on the commutator showed six black spots, each about three inches wide after being shut down in the evening. A good stoning and considerable increase of brush tension remedied the trouble. Edward Steir.

Blackening of a Commutator. Ans. Ques. 494.

Editor Electrical Engineering:

The writer has read certain articles in *Electrical Engineering* where inquiries were made as to why certain troubles existed through brushes on the commutator. He has also read one or two attempts to offer suggestions as to why these troubles exist and how they could be overcome. The best way for the one having trouble to correct it, is to get into direct correspondence with a brush engineer.

Sparking, which covers a range from a slight glow to a heavy arc, may be caused by any one of the following reasons: High mica or hard mica; flash spots; low or high brush tension; cutting of the copper by a hard gritty brush; dry particles of carbon from the brush; wrong contact resistance of the brush; overloaded machines; brushes not properly set (By this is meant position not changed for varied loads or the brushes not in position with respect to the neutral point); unequal air gaps; defective fields; distorted magnetic field; incorrect spacing of the brushes; brushes of the wrong size.

The writer will be glad to give further information on any of these subjects if such is desired.

A. C. Bissell,

U. S. Carbon Company, New York City.

Calculating the Cost of Steam Power as Generated by Steam. Ans. Ques. No. 484.

Editor Electrical Engineer:

In what follows an attempt has been made to answer question 484 of the October issue of *Electrical Engineering* in a general way, using the machines given as a basis and assuming the other data on operation and cost of equipment that is required. It is first assumed that the plant is to serve the demands of a small town and provides 24 hour service. From the maximum demand and the average monthly consumption given by G. T. B., a probable load curve for such a plant is given in Fig. 1. This curve may not compare in its details with the actual conditions of G. T. B.'s plant, but inasmuch as the writer will attempt only to discuss operating conditions and layout of a plant on this assumed basis, the information and data given will be of greatest value in showing how to attack a problem of this sort rather than to give actual figures on which to decide the many sided question of a private small plant vs purchased service from a large distribution system.

From the load curve given we can determine the average load on the machines and their probable efficiencies and with this as a basis find the cost of the service. It is stated that the maximum demand is 230 kilowatts and the average monthly consumption 62,700 Kw.-hrs. If we assume 24 hours operation for 30 days per month, then we have the average load in Kw. per 24 hours as follows:

$$62{,}700 \div (30 \times 24) = 87.0 \text{ Kw.}$$

With this as the average load and 230 as the maximum load, the basis for the load curve is established and assuming that the maximum load takes place during the lighting period or from 6 p. m. to 11 p. m., the nature of the curve is approximated as shown in Fig. 1. From this curve it is at once seen that there is comparatively only a short period when the two machines, namely, the 200 Kw. and 75 Kw. generators, will be operated at the same time. The large machine could probably carry the total load from 4 p. m. to 6 a. m. and the small machine during the remainder of the period. Under these conditions both machines will operate under good conditions and be at or near (one side or the other) of full load rating. If we were to design a new plant of this character, the sizes of engines would be selected from the load curve with a view of getting sizes that would give best economy. In this case with the sizes already fixed, the steam requirements will depend upon the conditions as assumed.

We will consider the larger machine (320-IHP and 200 Kw.) to be a 4-valve engine, and the smaller machine to be a single valve engine. This small unit could be a 4-valve as this would be about the size of the smallest of this type. A steam curve of the 4-valve engine is given

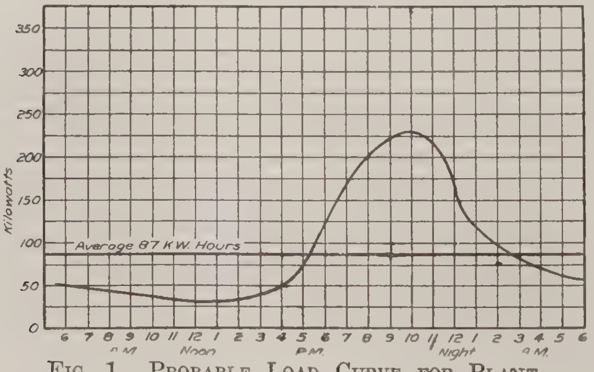


FIG. 1. PROBABLE LOAD CURVE FOR PLANT.

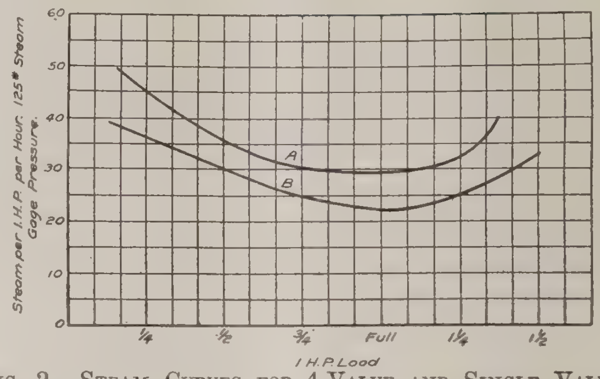


FIG. 2. STEAM CURVES FOR 4-VALVE AND SINGLE VALVE ENGINES.

in Fig. 2 and shows the steam required per horsepower for the different points of cut off. From the load curve we found that the machines would be running under about an average of ¾ load during the whole period, so we must figure on this point for steam economy and the total amount of steam required to operate the plant. On this basis for our large machine we would have at ¾ load about 27 pounds per I.H.P. per hour (assuming 125 pounds steam pressure at throttle) and on the small machine we would have a consumption of about 31 pounds per I. H. P. per hour. From this we see that the steam consumption per hour and per day is as follows:

For an average load of ¾ from 4 p. m. to 6 a. m., or 14 hours, the steam demand would be: $320 \times .75 \times 27 \times 14$ Hrs. $= 90{,}720$ pounds of steam, or 6,480 pounds per hour. For the small machine we would have: $120 \times .75 \times 31 \times 10$ Hrs. $= 27{,}900$ pounds, or 2,790 pounds per hour.

If we add up the Kw. demand for the 4-valve engine each hour, we find that the average is 140 between 4 p. m. and 6 a. m. The load comes on in such a way that not more than an average of ¾ load is carried by the engine. In the case of the small engine we will have an average load of about 38 Kw.

Converting this steam consumption into pounds per Kw. hour, we will have for this 4-valve engine,

$$6{,}480 \div 140 \text{ Kw.} = 36.3 \text{ pounds per Kw. hour.}$$

and for the small engine,

$2{,}790 \div 38$ Kw. $= 74$ pounds per Kw.-hour, or a total average per Kw.-hour for a 24-hour period of,

$[(46.3 \times 14 \text{ hours}) + (74 \times 10 \text{ hours})] \div 24$ hours $= 58.0$ pounds per Kw. hour.

We now are in a position to convert this average into pounds of coal per hour. We will assume an evaporation of 8 pounds of water per hour per pound of coal and from this we have, $53.5 \div 8 = 7.25$ pounds coal per Kw. hour, which is about what might be expected from a plant of this size and type. Converting this into cents per Kw. hour with coal at $3.00 per ton, we have,

($\$3.00 \times 7.25) \div 2{,}000 = 1.09$ cents per Kw. hour for coal.

We must charge the steam used in running the boiler feed pump to this item also, which would be about as follows: Going back, we require 6480 pounds of steam to operate the 4-valve engine and this is 216 boiler horsepower, which would require about 2.7 pump horsepower to operate the pump in feeding the boiler. A pump of this type would use not less than 70 pounds of steam per pump horsepower per hour, or a total of $2.7 \times 70 = 189$ pounds per hour, and since our average Kw. hours is 87, this would

require 189 ÷ 87 = 2.17 pounds per Kw. hour. From this we have 2.17 ÷ 8 = 0.275 pounds coal per Kw. hour, or ($3.00 × 0.275) ÷ 2000 = .04 cents per Kw. hour.

This gives the cost of fuel per Kw. hour. We must next determine the operating cost per Kw. hour, as well as the interest and depreciation for the installation.

For this size plant we would require a day engineer at

say $125.00 per month	$1,500.00
Night engineer at $100.00 per month	1,200.00
Two firemen at $45.00 per month each	1,080.00
Oil and waste $10.00 per month	120.00
	$3,900.00

Referring back we have an average monthly consumption of 62,700 Kw. hours from which we have,

$3,900.00 ÷ (62,700 × 12) = 0.52 cents per Kw. hour.

The first cost, interest and depreciation of the installation follow:

200 Kw. engine unit direct con.	$6,500.00
75 Kw. engine unit direct con.	2,500.00
4-panel switch board	1,000.00
3-125 horsepower boilers (one in reserve)	3,750.00
Pump, heater, piping, etc.	2,000.00
Building	2,500.00
Total	$18,250.00

The apparatus that would be required if central station power should be used is,

Building smaller than for steam	$2,000.00	
Switch board, same as above	1,000.00	
		$3,000.00
		$15,250.00
Interest on $15,250 @ .6 %	$915.00	
Depreciation @ .6 %	915.00	
	$1,830.00	

Then $1,830.00 ÷ (62,700 × 12) = .25 cents per Kw. hour.

We will not take into consideration the outside wiring as this would remain the same in either case, therefore total costs are:

Cost of coal per Kw. hour	1.09 cents
Cost of labor per Kw. hour	.52 cents
Cost of coal per Kw. hr. pumps	.04 cents
Cost of int. and depreciation	.25 cents
	1.90 cents per Kw. hour.

Since there is a loss between the generator, engine and the switch board, we must take this into consideration. This loss would be about as follows: Engine, 90 % efficient; generator, 85 % efficient. The combined efficiency is 90 × 85 = 76.5 %. From this we have,

1.90 ÷ 76.5 = 2.48 cents per Kw. hour at the switch board.

No account has been taken of overhead charges that would exist, such as management of the plant, clerical force, etc., all of which would remain about the same whether the current were generated in the steam plant or purchased from the central station.

Earl F. Scott, M. E.

Strength of Insulators vs Pins, Ans. Ques. No. 486.

Editor Electrical Engineering:

It will depend entirely on the condition of the pins and insulators as to which will give way first due to mechanical stresses. If the spacing distance or size of conductor is not properly taken, the space immediately surrounding the line will be badly overstressed, and this condition could be serious enough to char wooden pins and cause them to give way. Poorly designed 44,000 volt lines would be very apt to suffer from this cause, though the writer would hardly expect similar trouble on 11,000 volt lines, with ordinary construction. Metal pins would naturally be little effected due to leakage over them, and might help out in such cases.

Grounding Secondaries, Ans. Ques. No. 487.

The grounding of transformer secondaries is recommended by the National Board of Fire Underwriters and is required by many cities, provided the maximum difference of potential between the grounded point and any other point in the circuit does not exceed 250 volts. The ground connection must be made at the neutral joint of the transformer when the neutral is accessible. When the neutral point of the circuit is not accessible one side of the secondary circuit should be grounded. The neutral of a three wire A. C. system should be grounded every 500 feet. No. ground wire should be smaller than No. 6, and in the case of three-phase circuits, the ground wire should have a carrying capacity equal to that of any of the three mains. Ground wires must be attached to poles or buildings in a workmanlike manner using cleats or knobs. They must be carried in as nearly a straight line as practicable, avoiding kinks, coils, and sharp bends, and must be protected where exposed to mechanical injury.

Ground connections must be permanent and effective, and should be made to underground piping systems or to ground plates. Where ground plates are used a No. 16 Stubbs' gage copper plate about three by five feet, with about two feet of crushed coke both under and over it would make a ground of sufficient capacity for a moderate sized bank of transformers. The ground wire should be riveted to the plate in a number of places and soldered for its whole length. The joint between the plate and the ground wire should be thoroughly protected against corrosion by good water-proof paint.

Grounding to water pipes should be made by one of the approved forms of ground clamps now on the market.

Determining Power Taken by Machines. Ans. Ques. No. 489.

Probably the easiest way to determine the power required for driving machine tools is by means of an indicating wattmeter placed in the circuit of the motor driving the machine. This will give the watts input to the motor which is generally the information required. If it is desired to find the power required to run the machine alone, it will be necessary to determine or calculate the motor losses and subtract them from the wattmeter reading. This will give the watts required to run the machine which divided by 746 will give the horsepower required. This method will give approximate results which is all that is required for practical purposes. A 10 horsepower, 3-phase, 220 volt induction motor when running under normal no-load conditions would draw approximately 7.5 amperes.

Changes to Operate 440 Volt Motors on 220 Volts, Ans. Ques. No. 493.

If the motor in question has five coils in series per phase, per pole it would not be possible to reconnect it for 200 volts. A fairly satisfactory change can be made, however,

if the machine is "Y" connected by making a delta connected motor out of it. While a motor so connected would be a 255 volt motor theoretically, it will operate satisfactorily if the service requirements are not too exacting.

Most 440 volt motors will be found to have 4 or some multiple of 4, coils in series per pole, per phase, in which case it is an easy matter to reconnect the motor for 110 or 220 volts. The 4 coils are connected in series-parallel for 220 volts and in parallel for 110 volts. Most induction motors have their windings so designed that they can be connected for any commercial voltage.

Overload and No Voltage Release for Motor Starters, Ans. Ques. No. 495.

The actual diagrams of connection for the different types of over-load release are given in various hand-books and bulletins, or will be furnished by manufacturers, so that it does not seem advisable to give space to them here.

The no-voltage release is required by the underwriters on all motors, both alternating and direct current, and as its name implies is for the purpose of disconnecting the motor when for any reason the power supply is interrupted. In the case of the D. C. motor the no-voltage release is a small electromagnet usually connected in series with the shunt field, and placed so that it holds the starting rheostat handle closed against the tension of a spring. For the A. C. motor the no-voltage release is a small electro-magnet shunted across the motor terminals and arranged to trip out the starting compensator when the supply is interrupted.

The over-load release is an electro-magnet with a few turns of heavy wire connected in series with the motor supply and arranged to disconnect the motor from the circuit in case of excessive over-loads. It accomplishes its purpose in case of the A. C. motor by opening the circuit to the no-voltage release, and in case of the D. C. motor it usually short circuits the no-voltage release, allowing the starting rheostat handle to fly back to starting position.

It may be well to note that the National Code rules require the use of fuses with each motor whether it is provided with an overload relay or not. For this reason the use of overload relays on starting rheostats and starting compensators is not very common. They are very extensively used, however for large or important power installations.

F. J. Rankin.

Grounding Secondaries. Ans. Ques. No. 487.

Editor Electrical Engineering:

After many years of heated controversy, the opinion now prevails almost unanimously, that it is highly desirable to ground secondaries, and the National Electric Code makes it mandatory to ground one side of all circuits up to 150 volts. Central station and insurance companies now fully recognize that by so doing their customers are protected to some extent from shock and injury due to faulty transformers and line troubles, and that the expense of grounding is small in comparison with the cost of lawsuits and the financial losses resulting from fire and accidents.

The best ground that can be obtained is to connect to a complete metallic underground piping system, each service being grounded where it enters the building. When many customers are served in a limited area it is often advantageous to run a neutral wire along the pole, grounding it not less frequently than every 500 feet. Ground connections to gas pipes are not permitted, on account of the danger from explosion. The ground wire should be kept outside of buildings where practical to do so; when it is necessary to ground inside, the ground wire should be insulated with a rubber covering suitable for 600 volt service. A ground wire smaller than No. 6 B & S gage should not be used, this being the smallest size allowed by the National Fire Protection Association. When the wire must pass through walls or partitions or any other part of a building, porcelain bushings must be used.

The claim is often brought up that connecting secondary alternating-current mains to water pipes may cause electrolysis, but it has been amply demonstrated that alternating-current does not produce destructive electrolysis.

In connecting the ground wire to the piping system, the wire should be sweated to a lug of approved design, the lug being then bolted to the pipe in such a manner as not to permit the contact to be affected by rust. In those cases where a piping system is not available, grounding may be accomplished by the use of iron pipe or such devices as are now on the market for this purpose.

As a poor ground connection may, under certain conditions, be worse than no ground at all, care should be taken to obtain a ground of low resistance and one that will remain so. No ground rod or plate should go down into the eart less than six feet. A ground connection is made by electrolytic conduction and to obtain a good connection of low resistance, electrolytic moisture in contact with the ground plate must be obtained over a large area.

I should suggest that Querist obtain a copy of the National Electric Code, as compiled by the Electrical Committee of the National Fire Protection Association and that he may familiarize himself with their requirements. All the large cities, and many of the small municipalities, have rules covering electrical installations, which are in some cases more stroingent than those of the Electric Code.

I. L. K. Rankin.

Inductance of Coiled Circuits With and Without Iron Core. Ans. Ques. 490.

Editor Electrical Engineering:

The most accurate method for determining inductance of a coil is by calculation from the measured dimensions. This calculation can be carried out only when the coil is very simple in shape, and even then the calculation is quite complicated.

The best method of procedure in practice is to make approximate calculations by constructing a coil somewhat similar to the one to be used, testing it and then modifying the constants of the empirical formula for subsequent designs of the same type. Due to the intricacy of a problem of this nature a simple condition must be assumed for obtaining a fundamental formula. The equations given below apply to a straight coil with a depth of winding of wire small in comparison to the radius of the coil and the radius in turn being small in comparison to the length of the coil.

(1) *Without Iron Core,* $L = 2.408\ z^2\ r^2\ x$.

(2) *With Iron Core,* $L = [(61.\ z) \div x]\ (x_0 + 18.02\ r^2)$

Where L = Inductance in abhenrys; z = Number of turns per inch; r = Radius in inches; x = length of coil in inches; x_0 = Length of core in inches. One Henry equals 10^9 abhenrys.

E. J. Dailey, Jr.

ELECTRICAL ENGINEERING

DANIEL H. BRAYMER, Editor.

Devoted to the generation, transmission and distribution of electrical energy for lighting, heating, power and traction. Correspondence suitable for the pages of ELECTRICAL ENGINEERING is solicited and paid for. Name and address of correspondents must be given,—not necessarily for publication.

Published monthly by the W. R. C. SMITH PUBLISHING CO., at Dalton, Ga.; editorial and advertising departments, Grant Building, Atlanta, Ga. Entered as second-class matter at the postoffice at Dalton, Ga. Subscription rate $1.00 for two years; Canada $1.00 a year; foreign $1.50 a year.

Vol. 47. FEBRUARY, 1915. No. 2.

CONTENTS.

The dreadnaught California, to be constructed at the New York Navy Yard, will be the first battleship propelled by electric motors.

Edison is credited with the statement that the United States will soon be operating all its battleships by $15,000,000 worth of storage batteries.

X-ray apparatus has recently been used in examining bales of cotton consigned to Germany, when suspected of containing munitions of war or other contraband goods. Another meeting of science and commercialism.

The Edison Weekly reports that Dr. McCaa, the inventor and perfector of the wireless telephone, is now using Edison service for his wireless telephone station in the South Ferry Building, New York City. Dr. McCaa has succeeded in talking with vessels 100 miles at sea.

Germany's two great electrical manufacturers, the Allgemeine Geselleschaft and Siemens and Halske Co., did a gross business last year of about $170,000,000. Much of the apparatus was purchased by other than European firms. Where are these floating orders now going?

The Nigger in the "Word-Pile."

With all of the information that has been published on developments in the art of lighting and the present efficiency of modern types of incandescent lamps over the older lamps it would seem that few people at all interested in lighting, need be in the dark as to why it now costs less to light city streets than five years ago. We present in what follows the arguments advanced by a Southern municipal press agent for a saving in street lighting costs.

"Under the old contract that descended to the present commissioners from the Board of Mayor and Aldermen which expired Dec. 9, 1914, the city of ———— had in use upon its public streets a total of 485 electric lights. The above contract was dated Dec. 9, 1909, and was for a period of five years. The cost of operating the 485 lights under this old contract was $27,476.64 a year, or a total for the contract period of five years of $137,383.20.

"In the beginning of the new five year contract, dated Dec. 9, 1914, the city has upon its public streets 707 electric lights and the cost of operating them under the new contract is $16,769.05 a year, showing a saving to the city per year over the old contract of $10,707.59, or a total saving for the contract period of five years of $53,537.95 on the basis of 707 lights now in operation. This number of lights is to be increased by an additional 197 yet to be erected, bringing the total up to 904, with the yearly total cost to the city of $21,236.05, or $106,199.25 for the five years.

"We have now 412 more lights on our sreets than in 1911, and hence the value of these lights represents an increment gain to the tax payer, because we pay no more for the 904 lights we now have than we paid under the old contract for the 485 lights.

"Then, to express the subject differently, let us suppose that no question had arisen upon the cost of lights to the city, and terms and prices under the old contract had been affirmed and renewed, how then would our taxpayers be affected in the enjoyment of 904 electric lights? Let us see!

"If 904 lights had been arranged for under the prices and terms of the old contract it would have cost the city $47,219.52 a year, or for the contract period of five years $236,097.60. Under the new contract the same number of lights will cost the city, as shown, $21,239.85 a year, or for the five years $106,199.25—showing a net saving to the city of $129,898,35 for that period. As to the relative efficiency of the new lamps as compared to those used under the old contract, it is not too much to say that the new lamps are superior in candle power and general utility.

"The exhibit here is a lucid and strong illustration of the importance of having competitive bids for city service wherever it is possible. Competition was secured in this case and the present low cost of city lighting is due to that fact."

The nigger in the wood-pile or "word-pile" in this case, is the increase in the efficiency of the lamps now used by the city referred to, over the efficiency of the lamps on which the old contract was based. The facts concerning the lighting equipment operated under the old contract expiring December 9, 1914, are as follows: 383 alternating current 6.6 ampere series arc lamps consuming 425 watts were installed and operated at $68.04 per annum or $26,059.32; 126 tungsten series incandescent lamps of 40 candlepower were installed and operated at $18.72 per annum or $2,358.72. The total number of lamps operated under the old contract was 509 and the total cost per year $28,418.04. Only 485 lamps are accounted for in the above report. As a

matter of fact 6..36 lights were being used up to December 9th, 1914. From May, 1913, until December 9th, 1914, the city was furnished free of charge, current for the operation of 112—500 watt, 6.6 ampere luminous arc lamps and 15 cluster standards of a white way system. No mention is, of course, made of this gift.

Under the new contract the types of lamps named above have been replaced by newer and improved types and will be operated according to the following schedule:

112—6.6 ampere luminous arc white way lamps at $45 per year	$ 5,040.00
15 five lamp clusters with each lamp 80 candlepower nitrogen filled at $45 per year	675.00
457—250 candlepower nitrogen filled series tungsten lamps at $26.45 per year	12,087.65
18—100 candlepower nitrogen filled series tungsten lamps at $20 per year	360.00
238—80 candlepower nitrogen filled series tungsten lamps at $19 per year	4,522.00
Total yearly cost	$22,684.65

All lamps except the white way lamps burn 4000 hours per year, the white way lamps burning 2190 hours per year. The changes in types of lamps give much better lighting than before besides permitting the use of practically double the number of lamps. The rates and the comparisons of yearly costs under the old and new contracts are entirely due to the lower current consumption of the nitrogen filled tungsten lamps as against the older types of series tungsten lamps and a less cost of maintenance. This is illustrated by the fact that the 40 candlepower tungsten series lamp under the old contract cost the city $18.72 per year and consumed more current than the 80 candlepower nitrogen filled lamp under the new contract with a rate of $19.00 per year. The illumination in the latter case is, however, about twice that of the former.

In other words the increase in number of lamps to double that under the old contract at a saving per year of some $5,734 in operating costs, must be credited not to competitive bids but to the advancement in the art of lamp manufacture making it possible to secure one candlepower of light from about 0.5 watts as against 3.5 watts some five years ago.

There may be others who are in the dark on this matter of making lighting contracts, and central station managers should get busy themselves when new contracts are made and do a little press agent work on their own hook, showing that they are continually delivering a better product at a lower cost. Otherwise our news-hungry friends, the public and their political representatives, will continue to refer to our progressive cities as examples of looted prizes of central stations and excuses for competitive operation.

Christmas Appliance Campaign Among Byllesby Properties.

Reports from the Byllesby electric properties indicate the sale of from 15,000 to 18,000 lamp socket appliances such as flat irons, toasters, percolators, etc., during the holiday appliance campaign. This campaign was put on in cooperation with the electric supply dealers at the various properties and reports show the sale of twice as many appliances in the 1914 campaign as in any previous holiday sales. The best report was received from the Arkansas Valley Railway Light & Power Company, Pueblo, Colorado, where a total of 1,399 appliances were sold in Pueblo and other communities served by this division, compared with 531 appliances sold last year. The Consumers Power Company, Minot, North Dakota Division, sold 243 appliances compared with 67 in 1913. The El Reno, Oklahoma Company, sold 214 compared with 59 in 1913. Enid, Oklahoma, sold 176 compared with 34 in 1913. Faribault, Minnesota, sold 392 compared with 102 in 1913. Richmond, California, sold 194 compared with 69. Sioux Falls, South Dakota, sold 309 compared with 80 in 1913.

All Byllesby electric properties reporting for the week ending January 1 showed net connected load gains of 127 customers with 375 kilowatts lighting load. Output of the properties for the week showed an increase of 7.5 per cent over the corresponding week of last year. The manufactured gas output increased 4.9 per cent.

Pension System of Union Electric Light and Power Company of St. Louis, Mo.

Effective with the New Year the Union Electric Light and Power Company, of St. Louis, has announced the inauguration of a pension system, an outline of which is as follows:

Employes may retire from active service with the company and be entitled to pension allowances in accordance with the following conditions: (a) Any employe who shall have reached the age of sixty years and shall have been in the service of the company continuously for fifteen years or more preceding retirement may, upon request, retire from active service with a pension for life. (b) Any employe who shall have reached the age of seventy years and shall have been in the service of the company continuously for twenty years or more next preceding the date upon which the above age shall have been reached, unless exempted by a special ruling of the general manager, shall be retired from active service with a pension for life.

The amount of annual pension allowance to be paid each year to an employe retired under the pension system is to be for the present on the following basis: One and one-half per cent of the average annual salary or wage received during such employe's last ten-year period of service multiplied by the number of years of such employe's service, provided in no case shall the annual pension allowance paid to any employe be less than two hundred and forty dollars, and not more than forty per cent of the annual average wages during such ten-year period. For the purpose of computing the pension allowance, that portion of the annual salary or wage in excess of fifteen hundred dollars shall not be considered.

The pension payments are to be made monthly in equal amounts. They are not to be assignable or subject to any liens at law, or otherwise, and may be revoked if abused.

The installation of lighting equipment for the Panama-Pacific Exposition is practically complete. The schemes of lighting are entirely new and the lighting effects show as never before the developments of the art. One hundred thousand glass jewels have been mounted on the Tower of Jewels and will reflect varied colors like real jewels. Forty-eight projectors will pour a flood of gorgeous auroras over the exposition buildings and make possible spectacular effects on clouds produced by banks of steam. This is only one feature, there are hundreds of others. All building lighting is equally elaborate so as to make the architecture stand out at night equal to that in daytime.

Concerning the Electrical Trade

News of Activity by Jobbers, Dealers, Contractors Central Stations and Manufacturers.

L. L. Shivers, Vice-President W. E. Carter Electric Company, Atlanta, Ga., In Seven Years Builds A $300,000 Electrical Supply Business In The State of Georgia.

The formula for success in the electrical supply business which has in many cases been poorly compounded by practical electrical men and capable engineers, is not so complicated as many seem to believe. It is in fact not much different from the formula for success in any other business. In the main, the formula for success in the electrical supply business calls for an ambitious, persistent and honest manipulation of the laws of supply and demand by one or more men possessing a commercial instinct plus technical training and practical experience. The elimination of any one of these qualifications changes the formula for success into one for bare existence if not failure. Especially is it noticeable that with the best of technical training and the most extensive of practical experience and a lack of all the rest, the formula spells disaster and financial ruin.

As an example of how the success formula works when it is properly made up, we refer to the W. E. Carter Electric Company of Atlanta, Ga., of which company Mr. L. L. Shivers is vice-president and general manager. Back in 1908 this company was doing a wiring and small supply business in Atlanta with a store at 12 Walton Street. Mr. Shivers was then filling the role of electrical "peddler" for the company. During the year the company was reorganized with Mr. E. D. Kennedy, of Atlanta, president and Mr. Shivers called in to become manager. At that time a business of about $10,000 per year was being done, while today the present company carries a stock valued at $60,000 and does an annual business of about $300,000. During the past year a four-story and basement building at 72 North Broad Street, Atlanta, has been remodeled to meet their requirements, with one of the largest and most thoroughly equipped display rooms in the South. This business has been built in the short space of seven years, with very little capital at the start and practically no overhead expense in traveling representatives, a typical example of the possibilities for any well managed electrical supply business.

Mr. L. L. Shivers, vice-president and general manager of the W. E. Carter Electric Company, was born Jan. 7, thirty-nine years ago, in Baldwin County, Georgia. He was raised on a Georgia farm and at 14 took up railroad work as a section hand on the tracks of the Georgia Southern and Florida, and two years later was made section foreman, the youngest man to hold this position then or since in the state. After saving some money in this position he decided to go to college and entered the Georgia Military College at Milledgeville, Ga., of which Prof. J. C. Woodward, now president of the Georgia Military Academy at College Park, Ga., was president. On account of a lack of funds, Mr. Shivers left college during the sophomore year and took up telegraphy with the Postal Telegraph Company. This was about 1898. In the telegraph field he became one of the company's highest class "bonus" operators and in 1903 was made traffic manager at Augusta, Ga. He left the telegraph service in 1904 to become Southern manager of Miller and Company, New York stock and bond brokers, having charge of private wires in the South with headquarters at Augusta. When the legislature put an end to this business in the state of Georgia, Mr. Shivers secured a traveling position with the W. E. Carter Electric Company, of Atlanta, and was made manager as already stated.

L. L. Shivers, Vice-President and General Manager W. E. Carter Electric Co., Atlanta, Ga.

Besides being a member of the Society for Electrical Development and other commercial organizations, Mr. Shivers is a member of the Rotary Club of Atlanta, the Atlanta Chamber of Commerce, the Builders Exchange, the Georgia Chamber of Commerce, and the Capital City and Elks Clubs of Atlanta. He is also a 32nd degree Mason and a Shriner.

The sales organization of the W. E. Carter Electric Company has been built up by Mr. Shivers from time to time as the business has grown. It now consists of Mr. P. C. Gilham, sales manager, a well known electrical engineer and contractor, Mr. A. F. Hammond in charge of the wholesale department, Mr. F. S. McGaughey in charge of the fixture department and Mr. A. H. Shirley traveling representative for the state of Georgia, with several assistants.

The company has recently been appointed General Electric distributors for the state of Georgia and carries the following lines in addition, acting as jobbers and doing a retail business in Atlanta.

Schedule Goods and Wiring Devices.
    General Electric Company, Schenectady, N. Y.

Lamps.
    General Electric Company, Schenectady, N. Y.

Flashlights and Batteries.
    American Ever Ready Co., N. Y. City.; National Carbon Co., Cleveland, Ohio.

Reflectors and Glassware.
    Holophane Works of G. E. Co., Cleveland, Ohio.

Window Display That Took First Prize in Atlanta Rotary Club Contest.

Electric Fans.
General Electric Company, Schnectady, N. Y.
Dayton Fan & Motor Co., Dayton, Ohio.
Heating and Cooking Devices.
General Electric Company, Schnectady, N. Y.; Hot Point Electric Heating Co., Ontario, Calif. Hughes Electric Heating Co., Chicago, Ill.
Vibrators, Hair Dryers and Vacuum Cleaners.
Hamilton Beach Co., Racine, Wis.; Premier Vacuum Cleaner Co., Cleveland, Ohio.
Shade Holders and Shades.
Harvey Hubbell, Inc., Bridgeport, Conn.
Switches and Panelboards.
Trumbull Electric Mfg. Co., Plainville, Conn.
Pole Line Hardware.
Schaper Construction Material Co., New York City.
Lineman's Construction Tools.
Smith and Hemenway Co., New York City.
Conduit—Rigid.
American Conduit Mfg. Co., Pittsburgh, Pa.
Conduit—Flexible and Fittings.
Sprague Electric Works of G. E. Co., New York City.
Conduit—Non-metalic.
National Metal Moulding Co., Pittsburgh, Pa.; Alphaduct Co., Jersey City, N. J.
Electrical Instruments.
Weston Electrical Instrument Co., Newark, N. J.; American Ever Ready Co., New York City.
Intercommunicating Telephones.
DeVeau Telephone Mfg. Co., Brooklyn, N. Y.
Indirect Lighting and Window Fixtures.
National X-ray Reflector Co., Chicago, Ill.
Portable Lamps and Fixtures.
Edward Miller and Co., Meridian, Conn.; Fairies Mfg. Co., Decatur, Ill.
Lighting Glassware.
Phoenix Glass Co., New York City and Pittsburgh, Pa.; Jefferson Glass Co., Follansbee, W. Va.
Street Lighting Fixtures.
George Cutter Co., South Bend, Ind.

Deposit for Residence Service Abolished by St. Louis Central Station Company.

On December 14th, the Union Electric Light and Power Company announced in the St. Louis daily papers that the custom of requiring a deposit of prospective consumers of residence service was abolished. In addition to this, those of the present residence consumers, who had made deposits, will have their money refunded to them. Since there are about 30,000 residence consumers who have made deposits, the new ruling will necessitate the refunding of quite a sum, and the announcement has brought forth considerable favorable comment in the daily papers, showing that the company's policy of rendering its customers the best service at the most liberal terms in accordance with its "Public Be Pleased" policy, is appreciated by the Public.

Edison 1914-15 Accounting Course.

The Educational Committee of the Association of Employes of The New York Edison Company has recently announced the opening of courses in bookkeeping and accountancy for the season of 1914-15.

The school will offer two courses this season. First, the University Bookkeeping Course, offered last year, will be repeated; second, a second course in the Elements of Accountancy will be offered.

The committee has in preparation for the season 1915-16 a third year course in Advanced Accounting, so that the complete course as finally presented beginning with the season 1915-16 will consist of three years work.

Electric Washing Machine Costs—A Sales Argument for the Central Station.

The new business manager and salesman of the central station must be able to prove to the modern housewife interested in the economical management of her home in the same way that her husband is interested in the scientific management of his factory or business, that electrical devices used in the home are economical. The washing machine, for instance, is the most economical of all the household helps, and as such should prove a leader for every salesman. A reliable make of washing machine is obtainable at a cost of $85. It is an actual fact that 90 per cent of the bed and table linen and 75 per cent of other articles are worn out, not by actual wear but by the tear and rub on the clothes when washed on the old-fashioned washboard. The expense of this washrboard rub and tear in the average family of five, will amount to about $80 per year, or $400 in five years. Furthermore, for the housewife who does her own work or employs only one maid, there is the additional expense of a laundress. A good laundress is hard to get, and even then you have to pay a dollar and a half or a dollar and sixty cents per day and provide her with one or two meals, a total of about $2 per day, or $100 per year, so that in five years the amount involved is something like $500. Thus, a family that is not equipped with one of these electric washers is spending about $900 in five years.

In comparison with this expense, we have an initial investment of $85 for the washing machine and a cost of

about 2 cents per hour, or not more than $3.00 per year for current to operate it. Figuring the cost of the washer, interest on investment, possible repairs, etc., an initial investment of less than $100 would be required for the first year, which, with a cost of $5 for each of the next succeeding four years, would make a total cost of $120 for the five years. This figure is approximate, and in the majority of cases the cost will run much lower.

Assuming for argument's sake, that one-half of the $400 wear and tear depreciation on the linen and clothing of the average family of five for five years is due to the discarding of old styles and their replacing with up-to-date pieces, we have $700, representing the cost of a laundress and the depreciation due to the wear and tear of the washboard, as compared with $120 for the family which has a washing machine, or a net saving of $580 in five years. You can readily see that it is a comparatively simple piece of sales work to prove the value of a washing machine from a cost standpoint alone.

Central stations as well as other successful business getters, must be careful, reasoning merchants and must plant their business as consistently and as conscientiously as any other industry, so when you are considering the advisability of selling washing machines, do not look only at the profit which you will make on the sale and then at the increase in your load, but consider carefully how firm a foundation is made for the sale of other electric household helps. W. D. Lindsey.

Production of Copper in 1914.

According to figures and estimates collected by B. S. Butler, of the United States Geological Survey, the copper production of the United States in 1914 will show a marked decrease from that of 1913. Reports have been received from all plants known to produce blister copper from domestic ores and refined copper. At an average price of about 13.5 cents a pound, the 1914 output has a value of $152,400,000, compared with $189,795,000 for the 1913 output. The large decrease in production in 1914 was due to curtailment of production during the latter part of the year on account of the reduction in tonnage exported to Europe.

Smelter production.—The figures showing smelter production from domestic ores represent the actual production of most of the companies for 11 months and an estimate of the December output. The November figures for a few companies furnished estimates for the last two months of the year. According to the statistics and estimates received, the output of blister and Lake copper was 1,129,000,000 pounds in 1914, against 1,224,484,000 pounds in 1913.

Refined copper.—The statistics and estimates indicate that the output of refined copper from primary sources, domestic and foreign, for 1914 was 1,493,000,000 pounds, compared with 1,615,067,000 pounds in 1913.

Imports.—According to the Bureau of Foreign and Domestic Commerce, the imports of pigs, ingots, bars, etc., for the first 11 months of 1914 amounted to 187,433,676 pounds, and the copper contents of ore matte and regulus amounted to 97,348,866 pounds, a total import of 284,782,542 pounds. This compares with an import for the 12 months of 1913 of 409,560,954 pounds.

Exports.—The exports of pigs, ingots, bars, plates, sheets, etc., for the first 11 months of 1914, as determined by the Bureau of Foreign and Domestic Commerce, amounted to 780,048,777 pounds, compared with an export for the 12 months of 1913 of 926,441,142 pounds.

Domestic consumption.—At the beginning of 1914 there was about 90,000,000 pounds of refined copper in stock in the United States. This added to the refinery production gives a total available supply of about 1,583,000,000 pounds of refined copper. On subtracting the export from this, with an estimate for December, it is apparent that the supply available for domestic consumption is materially below the 812,000,000 pounds of 1913, without taking account of stocks held at the close of the year.

Prices.—The average price of copper for 1914 showed a decrease from that of the preceding year, being about 13.5 cents a pound, compared with 15.5 cents in 1913. After the outbreak of the European war copper sold considerably below the yearly average, but toward the close of the year the price showed notable improvement.

Shortage of Electrical Supplies in Argentina.

According to a recent report, a recent call for tenders for electrical material for the Provincial Telegraph Department of Buenos Aires produced no offers. Inquiries made by the Department reveal the fact that this abstinence on the part of the firms usually tendering was due to their not having the goods in stock, with no immediate probability of receiving further supplies owing to the war in Europe. It has been decided to purchase some of the articles more urgently required at retail establishments.

St. Louis Company Changes Name of Employees Publication.

The Union Electric Light and Power Company, of St. Louis, Mo., established a company publication for its employes two years ago, which has been known as the "Union Electric Bulletin." This publication has grown to be a newsy journal of some 36 pages devoted to operating and commercial activities of the company. The January issue appears under a new name of "Wire and Pipe," with the following message:

"Greetings, my readers. With this issue, under a new name, I enter my third year of life. Will it be successful? Shall I fulfill my destiny? It is for you, my readers, to answer these questions. For I am what you make me. I am an effect, not a cause. I am the mirror that reflects the views of my readers. If, in the past, I have at times been dull, uninteresting and prosy, the fault lies at your door. For then you have not taken proper interest in me, and have not supplied me with news items. For I cannot make news, but can only repeat what I am told.

"When I am witty, interesting, full of fun, and a pleasure to receive, again I am but the reflection of the interest taken in me. I want news, plead for it, because I want to be successful. I want to truly represent all my readers; want to know all of them; want to hear from all of them.

"So I again ask, will you do your share towards making my third year of life my most successful one?"

This we believe is an excellent way to weld together the interest of employes in the company's work and secure the cooperation of all.

Designs of 1915 Fan Motors

Diehl Fans.

The fans offered by the Diehl Manufacturing Company of Elizabeth, N. J., for the 1915 season of the desk and bracket design embody a light frame construction of pressed or drawn metal. The alternating current designs have an induction type motor with centrifugal cut-out which removes all starting resistance when the fan has attained full speed. This has been determined as the most efficient method of construction and that which uses the smallest possible amount of current for operation. Field and stator frames are made up of steel laminations which add largely to the efficiency of the fan.

Fig. 1. The Diehl 12 Inch Six Blade Pressed Metal

Wick oil cups are inserted in the under side of bearings and give adequate lubrication to the shaft. Excess oil is returned to the cups through channels provided for that purpose. Renewal of oil is infrequent, although it is recommended that the cups be filled once a season. A double ringed guard of sufficiently heavy construction, supported by four radial arms and assembled without the use of solder provides a suitable means of handling fans for unpacked transportation.

The Bakelite method of commutator construction is used throughout the Diehl line of fans. This is a positive and permanent insurance against grounded commutator bars and eliminates any possibility of expansion or contraction due to heating and cooling. Bakelite commutators will not become oil soaked.

The Diehl oscillating mechanism consists of a worm and gear movement, entirely mechanical and with as few parts as is consistent with efficiency. This is entirely concealed within the body and runs freely in lubricant in a grease tight case. The range of oscillation is adjustable from zero to 90 degrees in three steps by turning a knurled head in the underside of the revolving disc which can be done safely while the fan is in motion. Blocking the fan body while it is in motion actuates a safety device and oscillation is temporarily suspended until the impediment is removed, thus protecting the mechanism against damage. Speed regulators are provided giving three running speeds.

Fig. 3. The Diehl Alternating Current Ceiling Fan.

Designs of six blade residence fans are offered in 12 and 16 inch sizes with oscillating arrangements. These fans are built for both direct and alternating current and for desk and bracket use. Eight inch residence and telephone booth fans are also offered, as well as types of ceiling and exhaust fans.

A design of fan for hat cleaning establishments is shown in Fig. 4, which consists of a fan motor with extended shaft and totally enclosed cover mounted on a substantial base without ball joint. The hat block can be mounted on the shaft extension making a very useful device.

Other changes in the Diehl line will be announced later.

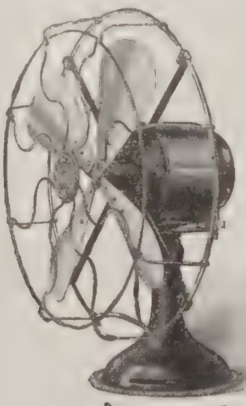


Fig. 2. The Diehl 16 Inch Oscillating Fan.

Fig. 4. The Diehl Hat Cleaners' Fan.

Dayton Fans.

The 1915 fans made by the Dayton Fan and Motor Co., of Dayton, Ohio, include an 8 inch design operating at a maximum speed of 1800 rpm. with two lower steps, and having blades set at an angle of 28 degrees. The claim is made that this fan will move 50 per cent more air than any other make of 8-inch fan.

A special six blade fan with an induction type of motor is also offered this year for residences, office and motion picture theater use. It has a maximum speed of 1100 rpm. with two steps down of 200 rpm each. The angle of the

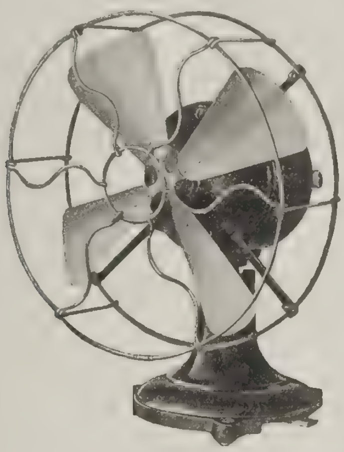


FIG. 1. DAYTON 8-INCH FAN.

blades is somewhat more than for regular four blade designs so that as much air is moved as by the higher speed four blade types.

The alternating current ceiling fan shown in Fig. 2 has a sweep of 60 inches. The blades are set at a normal angle such that at a speed of about 240 rpm. the fan creates good circulation. There are numbers of these fans operating throughout the country and have gained popularity on account of long life and lack of trouble in operation and maintenance.

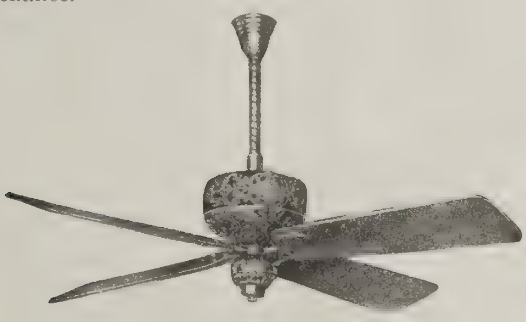


FIG. 2. DAYTON CEILING FAN.

Other designs of desk, bracket, oscillating and exhaust fans are offered in designs found in demand by the trade.

Westinghouse Fans.

All 1915 Westinghouse fans embody the drawn steel construction of frame and motor base developed three years ago. The motors of the alternating current desk and bracket designs are of the induction type, with split-phase starting and centrifugal cut-out switch. The motor starts positively on low speed at its lowest rated voltage, and with the fan tilted fully forward or backward. The starting winding is in circuit for a few seconds only so that there is no chance of burnouts, and the winding consumes current for a short period only. This type of winding has been successfully used for fan motors by the Westinghouse Company for years, and tests and experience prove it to be more reliable and much more efficient for 12-inch and 16-inch fans than the type of motor that has the starting winding in the circuit all the time, consuming current continuously.

Series-wound motors are used for 25-30-cycle fans because this type of motor is more efficient at low frequencies than the induction motor, and has a higher starting torque at low frequency. Series-wound motors also allow of higher speeds on low frequency than can be obtained with induction motors, thus giving greater air delivery. Direct-current motors are also series wound. Either series-wound motors or induction motors are furnished for the 50 and 60-cycle 8-inch fans. All other 8-inch fans are supplied with series-wound motors.

FIG. 1. WESTINGHOUSE 8-INCH DESK-AND-BRACKET FANS.

The primary laminations are riveted together and are pressed into the motor frame. In consequence there can be no vibration or humming, due to loose laminations. The laminations of inductionmotor rotors are riveted together, and the slots are skewed to insure quite operation. Series-wound motor armatures are of the drum type; the commutators have liberal wearing depth. The shafts are of hardened steel, ground to size, and will give service for years without appreciable wear.

The Westinghouse oscillating mechanism makes possible a swing from side to side of about 8 oscillations per minute. The mechanism requires about two watts for operation, and

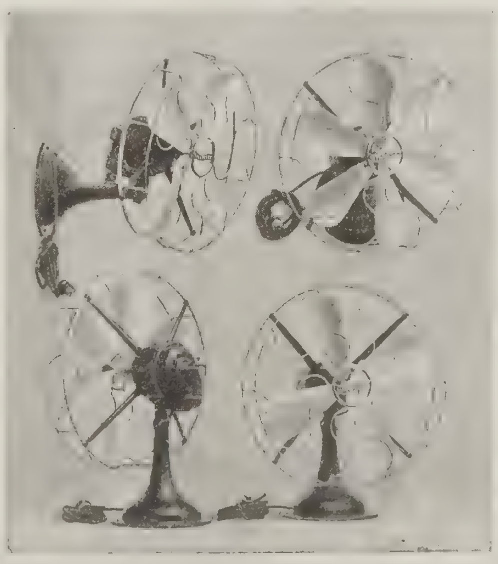


FIG. 2. WESTINGHOUSE 16-INCH DESK-AND-BRACKET FANS.

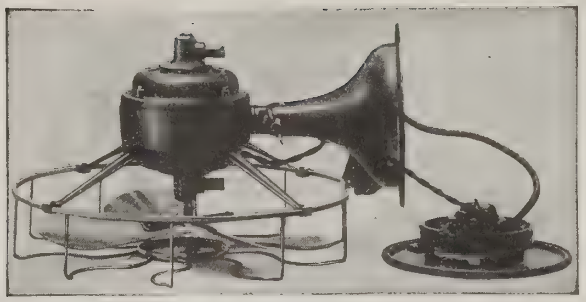


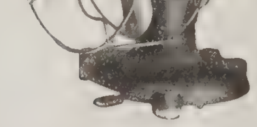
FIG. 3. SHOWING CONSTRUCTION OF FAN BASE.

does not affect the speed. It consists of a lever driven by a crank disc, which is operated from the motor shaft through two gear reductions, a worm and a spur. Both the worm wheel and the worm can be replaced without tools. The worm wheel drives through a ball clutch so that if the fan guard strikes an obstruction during the course of oscillation the fan merely stops oscillating without interfering with the operation of the motor. This prevents the burning out of the motor, the stripping of the gears, or the overturning of the fan.

The usual designs of Westinghouse telephone booth, ceiling, column, exhaust and blower fans are offered in types shown in the accompanying illustrations.

Peerless 8-Inch Fans.

The line of Peerless fans offered by the Peerless Electric Co., Warren, Ohio, includes a drawn scteel 8-inch alternating current oscillating fan. This fan is also offered without the



PEERLESS CAST FRAME 8-INCH OSCILLATOR.

oscillating mechanism. A cast frame 8-inch fan with commutator type motor for operation on both direct and alternating current circuits is also offered, with and without oscillating mechanism. This mechanism is the same as has been used for a number of years on the company's

THE PEERLESS DRAWN STEEL 8-INCH OSCILLATOR.

12-inch and 16-inch fans. This combination of 8-inch fans at attractive prices should appeal to the trade.

In addition to these 8-inch fans the company handles a complete line of alternating and direct current fan motors, both in the desk and oscillating types, and 12 and 16 inch sizes. Also a complete line of direct current ceiling fans, exhaust fans, multipolar motors and generators; bipolar fractional horsepower motors and generators; fractional horsepower single-phase alternating current motors and two and three-phase alternating current motors up to and including 2 horsepower.

General Electric Fans.

The 1915 General Electric fans include standard designs of 8, 9, 12 and 16-inch desk and bracket types and ceiling and exhaust fans. A new oscillating mechanism is offered this year and this type is provided with a convenient carrying handle. The oscillating mechanism consists of a crank disk operated by the slow speed shaft which projects through the lower section of the gear box, and carries the connecting rod. This rod swings at one end upon a stud fastened tothe stationary support and at the other end upon a crank pin which is adjustable with relation to the center of the crank disk. The upper adjusting nut which throws the oscillator "in" and "out" and the lower adjusting nut which changes the arc of oscillation are easily actuated while the fan is in operation. An additional adjustment in the pedestal permits swiveling the ring mounting for fan body and therefore the center of oscillation within a range of 90 degrees. Thus the oscillator, having a maximum stroke of 90 degrees and a swivel adjustment of 90 degrees, may be adjusted to any point within an arc of 180 degrees. A simple friction device in the reducing mechanism prevents the motor from overturning or burning out should it encounter an obstruction during the stoke of oscillation. The steady and graceful operation is due to a two-bearing support for motor body, straight connecting rod and a correctly designed train of gears.

The residence fan is designed for extreme quietness in running. It differs from the corresponding standard designs only in having a slow-speed operating characteristic and a 6-blade fan. This type of fan has a wide field of usefulness in residences, hospitals, offices, theaters, etc. The 8-inch stationary and oscillating desk fans are of drawn steel frame construction.

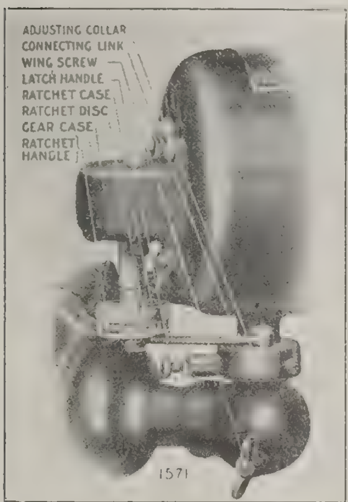
A so-called twin blower design is also offered as a ceiling arrangement with fans of 12 and 16 inches, making from eight to twelve revolutions per minute. On alternating current of 60 cycles and 110 volts, this design calls for about 120 to 180 watts consumption.

Emerson Fans.

The 1915 line of fans offered by the Emerson Electric Mfg. Co., of St. Louis, Mo., includes besides the fans heretofore made, a new design of 9-inch oscillating fan and new types of 12-inch desk and oscillating fans for 25 cycle operation. A small sweep six-blade ceiling fan for 60 cycle alternating current operation is also offered, suitable for hotel bedrooms, halls, etc. The company will continue the practice started last year of furnishing all desk and oscillating fans with plugs and ten feet of cord.

The 9-inch oscillating fan is in all essential features the same as the Emerson 1914 12 inch oscillator which is also included in the 1915 line. The oscillating mechanism in its

present form was introduced last year and is shown in the accompanying illustration. It consists of a positive acting single-link device operated by a worm and wheel, gear and pinion in a gear case at the back of the motor, the essential operating features of which are shown in the cut. The non-oscillating position is secured by means of a moving



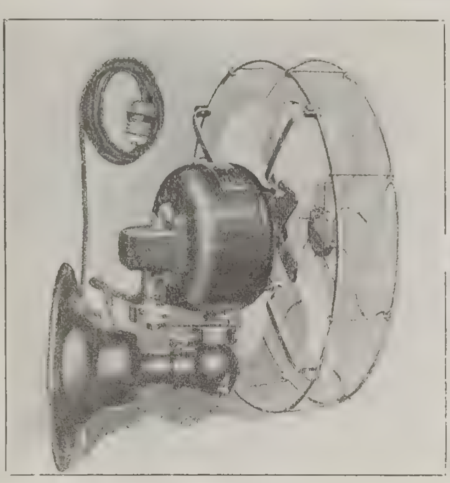


Fig. 1. Emerson Fan Oscillating Mechanism.
Fig. 2. Emerson 9-Inch Oscillator.

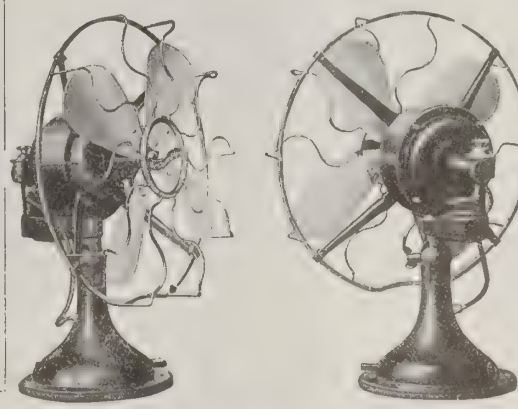
rachet in connection with which a ball clutch is arranged so that when the fan guard or motor strikes any obstacle, the arc of oscillation is automatically reduced to avoid danger to motor winding or mechanical parts.

All desk and bracket fans have the Parker patented fan blades and the alternating current types equipped with three speed induction motors. The direct current fans are the same as offered last year.

Western Electric Fans.

The accompanying illustrations show types of fans that possess a popular appeal to the trade. The eight-inch type shown in Fig. 1 has a convertible sub-base for desk and bracket use and operates on 25, 30, 40 or 50 cycles alternating current and 100 to 125 volts direct current. Oscillating types of 12 and 16-inch fans are shown in Figs. 2 and 3. These fans have a high efficiency and require only two watts more than the ordinary desk type with no reduction in speed. The oscillating arrangement is constructed so that when the fan guard strikes an obstruction the oscillation stops without interfering with the fan operation. About eight complete oscillations per minute are made over an arc of from 45 to 90 degrees.

All types of Western Electric fans have frames of drawn metal, making them strong yet light weight. For quiet operation in hospitals, theaters, etc., a six-blade fan is offered which operates at a slower speed than four-blade types, yet moves the same volume of air due to the extra blades. Types of telephone booth, ceiling and column fans are also offered together with designs of exhaust fans for restaurants, grill rooms, chemical laboratories, etc. The latter designs are made in 4 and 6-blade types, 12 and 16 inches and furnished with speed regulators.



Figs. 2 and 3. Western Electric Oscillating Fan of 12 and 16-Inch Sizes.

Fig. 1. Western Electric 8-Inch Fan.

Jandus Fans.

The Adams-Bagnall Electric Company, of Cleveland, Ohio, plans to exploit the sale of so-called Jandus Gyrofans during the 1915 season.' These fans are arranged for ceiling and column mounting as shown in Fig. 1, in designs with and without lights for operation on direct and alternating current. The Gyrofan is made in 12 and 15 inch sizes with a current consumption of 85 and 130 watts or direct current, and 90 and 180 watts on alternating current. They are said to cause a more complete circulation of air than the ordinary paddle type of ceiling fan. This company also makes direct and alternating current types of desk, bracket and oscillating fans.

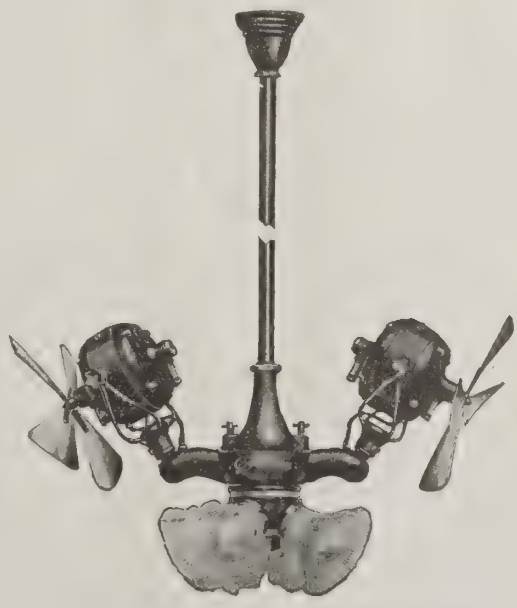


Fig. 1. The Gyrofan With Lights.

Eck Fans.

The fan shown in Fig. 1 is equipped with an oscillating mechanism introduced by the Eck Dynamo and Motor Co., of Belleville, N. J., in 1907. This oscillating arrangement is rugged and durable and has needed no change since first

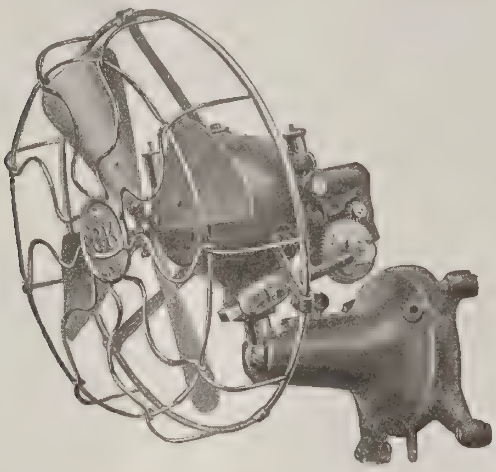


Fig. 1. The Eck Hurricane Oscillating Fan.

used. The oscillation of the fan is produced by worm gears submerged in grease. The external gear wheel is provided with a friction clutch which slips if the oscillating movement is in any way interfered with, preventing an overload on the fan motor and consequent burn outs.

Fig. 2. The Eck 8-Inch Inexpensive Fan.

A type of 8-inch fan is shown in Fig. 2 for operation on direct and alternating current. This fan is inexpensive, powerful and noiseless and suited to small offices and houses. The blades have a pitch of 30 degrees and the motor three speeds.

Fans go Through Fire and Still Operate.

The accompanying illustration shows two Robbins & Myers fans which went through the fire that occurred at the company's foundry a few weeks ago. Several hundred fans were stocked in a building adjoining the foundry, which burned to the ground. The photograph shows the condition of this stock of fans after the fire.

While watching the workmen digging these fans apart with picks so they could be loaded and carted to the scrap heap, one of the officers of the company became curious to know what the motors of these fans would do if current were applied to them. With the idea of finding out, an 8-inch desk fan and a 12-inch oscillator, both alternating current, were dug out of the ice and debris. The fans were both full of ice and the rotors were stuck fast with

Fans Recovered From Fire Ruins Shown in Operation.

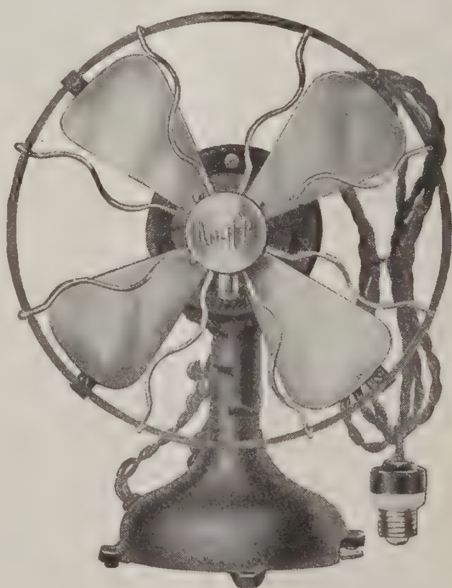
it. The enamel was all burned off and the guards and blades were warped and twisted out of shape by the heat.

After the current had been turned on sufficiently long to melt the ice in the motors, both fans started up, throwing the water out in a spray. The motion was somewhat jerky due to the twisted and unbalanced condition of the blades, but the motors continued to operate without mishap as long as the current was on. Apparently their operation was not affected in the least by the severe conditions to which they had been subjected.

Knapp Fans.

A line of 10-inch fans for operation on 110 volts alternating or direct current is offered by the Knapp Electric and Novelty Co., 525 West 51st Street, New York City. It is claimed that these fans do the work of the ordinary 10-inch fan at the price of an 8-inch. On 110 volts they consume 20 watts.

An 8-inch battery fan is also offered for use where current is not available, as on farms, and at small country summer resorts. The fan is of substantial design, with a motor operating at six volts from a storage battery or 20 good dry cells giving 200 hours operation. With batteries costing 25 cents each the operation cost is around 2½ cents per hour. The fan costs $7.50. The Western Electric Company acts as jobber for these fans.



The Knapp 10 Inch Fan.

Century Fans.

The 1915 line of fans of the Century Electric Co., St. Louis, Mo., includes designs of desk, bracket, oscillating and ceiling fans, all except the last being made up with drawn steel base.

The oscillating mechanism of Century fans consists of double steel worms and bronze gears mounted in a case packed with grease. The mechanism gives about four oscillations per minute to the fan. The speed reduction on all desk and oscillating fans is about 40 per cent on 60 cycle circuits of normal voltage.

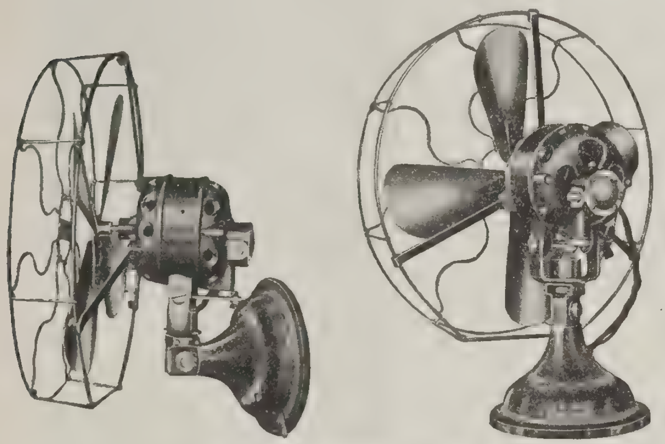
The Ceiling fan is practically the same design that has proven satisfactory for the last ten years. The armature revolves outside of the field, and the entire weight is carried on ball bearings immersed in oil. The blades have a sweep of 58 inches and a maximum speed of approximately 240 revolutions. Each fan is fitted with a two-speed switch. The oil cup is threaded for the reception of electrolier attachments.

Tuerk and H. E. Fans.

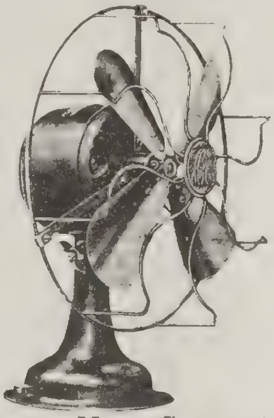
No particular changes have been made in the fans offered this season by the Hunter Fan and Motor Company of New York City. The company has found the standard designs offered heretofore satisfactory to customers, the line including ceiling, desk, bracket and exhaust types.

The leading design of desk fan is shown in the accompanying illustration. This fan is built in direct and alternating types with and without oscillating mechanism, and adjustable for desk or bracket use. The 12 and 16-inch designs on 60 cycle circuits take about 45 watts with three speeds. The alternating desk fan motor is designed for 25, 40, 50, 60 and 133 cycles, and voltages of 100, 115, 190 and 220. The direct current types also operate on an equivalent voltage range and have three speeds of about 1,000, 1,200 and 1,500.

The ceiling types of fans suit various requirements in plain and ornamental designs with and without electroliers. All motors are arranged for electrolier attachments for two or four lights.



Century Electric Fans.



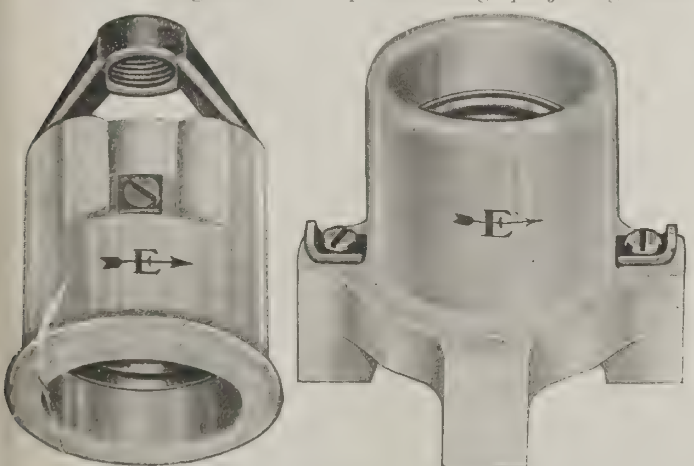
Hunter Fan and Motor Company's Desk and Bracket Fan.

New Apparatus and Appliances

A New Arrow E. Socket and Receptacle.

A new socket and receptacle for Mogul base lamps are shown in the accompanying illustrations. The socket with yoke is of the same overall length as the brass shell Mogul sockets already on the market and can be used with fixtures already designed for these brass shell sockets.

The receptacle shown here is adapted for exposed wiring and is so designed that the porcelain lugs projecting below the bottom surface of the receptacle allow an air space between the receptacle and the surface to which it is attached. Both of these devices are manufactured by The Arrow Electric Company, Hartford, Conn.



A New Socket and Receptacle for High Efficiency Tungsten Lamps.

Westinghouse Company Organizes New Department.

Probably in no portion of the field of electrical industry has there been so much progress in the last few years as in that of automobile accessories. The Westinghouse Electric & Mfg. Company a few years ago started the manufacture of starting, lighting and ignition outfits for gasoline cars, devoting its entire Shadyside Works to this line of manufacture. So extensive has been the growth of this business that the company organized on January 1st, a separate department for the production and sale of automobile accessories to be known as The Automobile Equipment Department of which Mr. G. Brewer Griffin is manager.

Mr. Griffin was formerly manager of the detail and supply department, having had active charge of automobile equipment sales from the inception of the business by the Westinghouse Company. He has been in the electrical business for some years, having started in 1889 with the Thompson-Houston Electric Co., at Lynn, Mass., with which company he remained until 1849, when he became associated with the Narragansett Electric Company at Providence, R. I. While with this company he aided in entirely re-

building and re-arranging their distributing system. In 1896 he went to Elmira, N. Y., and became manager of the jobbing contracting, and new business departments of the Municipal Improvement Company which was engaged in general construction supply business in connection with the water, street railway, and electric light plants.

In 1900 Mr. Griffin went with the Manhattan General Construction Company of New York, as special representative, opening an office in Boston as New England manager one year later, which position he held until the company was absorbed by the Westinghouse Electric & Mfg. Company, and he was assigned the Boston office. In 1902 he went to East Pittsburgh, as assistant manager of the detail and supply department, succeeding to the position of manager in 1909, which place he held until his appointment, January 1st of this year, as manager of the new Automatic Equipment Department.

An Electric Lantern and Flash Lamp.

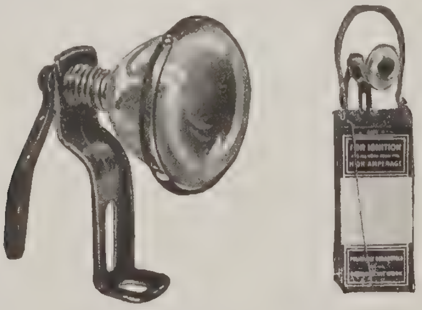
An electric lantern of servicable design is being offered by the Central Telephone and Electric Company of St. Louis, Mo. It uses a standard No. 6 dry cell in a metal case provided with a convenient carrying handle.

A New Portable Lantern.

A tungsten lamp is used which gives long hours service from a single battery. A bicycle and buggy lantern is also offered of similar design.

The Wonderlite.

The accompanying illustration shows a battery lamp attachment offered by Frederick Rall, 19 Park Place, New York City. The device can be attached to any standard dry battery and gives about 20 hours of continuous operation or double this time for intermittent service. It is



The Wonderlite Lantern.

found of use by motor cyclists, automobilists and in barns and stables on account of safety from fire.

New General Electric Primary Cutouts.

A line of expulsion type primary cutouts of improved design has been developed by the General Electric Company for outdoor use. They have standard ratings of 15 amp. 6600 volts, 75 amp. 6600 volts or 100 amp. 2500 volts. The main feature of the design is the safety afforded the operator in refusing the cutout. When the door is opened, the fuse holder is automatically disconnected from the circuit. The ring bolt and latch, with which the door is fitted, are well-separated from all live metal parts, so that it is entirely safe to handle.

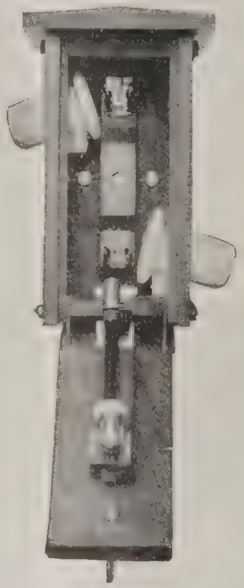


Fig. 1. A New G. E. 15-Amp. 6600 Volt Expulsion Type Primary Cutout.

The boxes are constructed of well-seasoned ash, oil-impregnated and further protected from weather conditions by an outside coat of brick japan. On the bottom of the box is an indicator in the form of a brass card receiver placed over the gas outlet of the expulsion fuse. Into this receiver can be slipped a white card, a square of oiled paper or a very thin sheet of white celluloid, forming a white target against the black background of the box that can be readily seen from the ground. The blowing of the fuse causes a discharge of gas from the end, which dislodges the card from its receiver. This feature obviates the necessity of climbing the pole to astertain the condition of the fuse.

Illumination for Operating Dredge at Night.

The accompanying illustrations show the equipment and methods used for illumination when operating the U. S. dredge Buras for levee building in the Mississippi valley. The equipment for lighting was designed and installed by S. T. Stewart of New Orleans, and consists of two Stewart illuminators for headlights and four three-light clusters of 60 watt lamps on the outside.

As the machine turns, there is always light on all sides. The base is provided with one five-light cluster of 60-watt lamps in the front, another in the back, and six 16-candle-power lamps distributed at other points. Current is supplied to all of these lights through a sliding contact and

FIG. 1. LIGHTING EQUIPMENT FOR U. S. DREDGE IN LEVEE BUILDING.

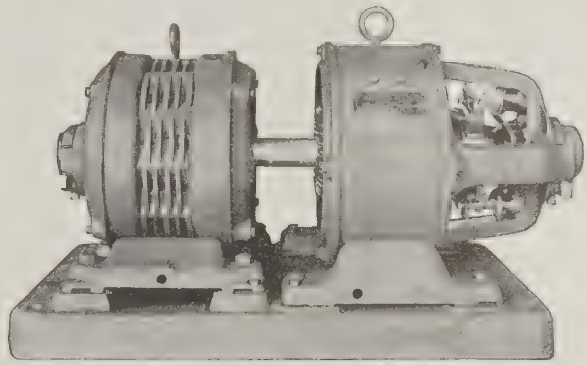
the house can turn completely around without twisting a wire. The inside of the house is lighted with one three-light cluster of 60-watt lamps and twelve separate 16-candlepower lamps.

FIG. 2. SHOWING DREDGE IN OPERATION AT NIGHT.

Current is supplied by a 7½-kilowatt, 125-volt, 1,000-revolutions per minute, direct-current generator, manufactured by the Robbins & Myers Co., Springfield, Ohio. The generator is belt driven by a steam engine. The dredge was manufactured by the McMyler Interstate Co., Cleveland, Ohio.

Motor-GeneratorSets for Moving Picture Machines.

Alternating current is very unsatisfactory for operating the arc of the moving picture machine. The alternating current arc is unsteady, tends to travel around the edge of the carbons, is hard to focus, and tends to go out. The direct current arc, on the other hand, is steady, easy to focus because the light comes mainly from a spot on the positive carbon, and gives about twice as much illumination as the alternating current arc does for the same amount of current.



WESTINGHOUSE MOVING PICTURE MOTOR-GENERATOR SET.

Since current as received from the central generating station is usually alternating, the motor-generator set to secure direct current has proved itself thoroughly satisfactory

The Westinghouse Electric and Mfg. Co. has designed a set especially for moving picture service. The generator has a high overload capacity and is so wound that it gives and delivers a potential of 75 volts at all loads, instead of allowing the voltage to drop as the load is increased as is usual with generators. These characteristics are of value because they enable the set to operate two moving picture machines at once (one projecting and the other warming up) without interfering with the picture being shown or altering the speed of the machine if motor-driven. Thus continuous picture service can be obtained from one set.

An Illuminated Electric Sign.

An electrically illuminated sign has recently been erected by The Texas Company, on one of its buildings at Port Arthur, Texas. The sign consists of fifteen nine-foot letters painted white forming an attractive sign by day, while at night it is also made attractive by special illumination A pea-green color is obtained from Cooper Hewitt lamps placed behind a reflector located in front of the sign as shown in Fig. 2.

The sign is 155 feet, 10 inches long, and 9 feet 2 inches high, supported by a substantial iron frame work on top of the building. The height above the top of the building is over 9 feet, thus making it easily visible. The light is furnished by sixteen type H. Cooper Hewitt lamps, mounted, as shown in Fig. 3, in iron boxes placed eleven feet in front of the sign. These boxes are of particular interest, being made of corrugated iron top and sides with a glass

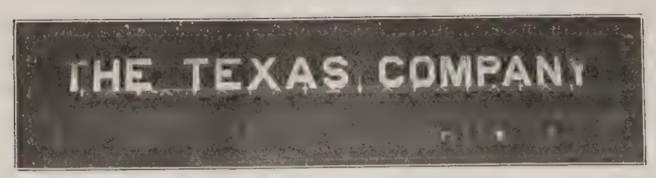


Fig. 1. Sign of Texas Company on One of its Buildings.

face just large enough to accommodate the lamp. A special reflector is placed just beneath the tube of the lamp and throws the light directly against the face of the sign. The lamps are operated four in series on a 240-volt direct-current circuit, taking $3\frac{1}{2}$ amperes in each circuit, or $192\frac{1}{2}$ watts per lamp. This gives a total energy consumption for the installation of approximately 3 kilowatts, making a very economical as well as an attractive sign.

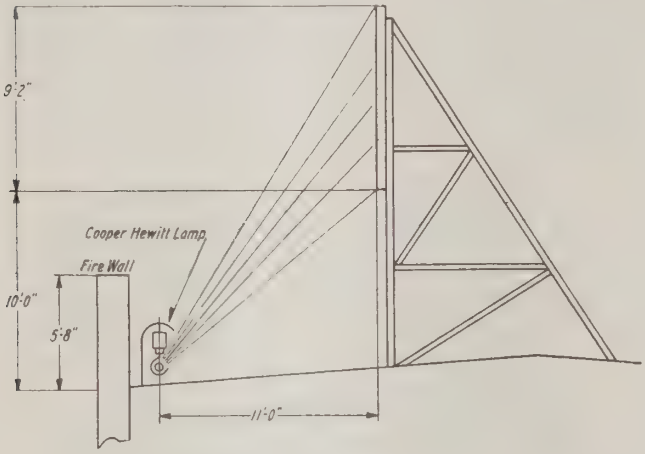


Fig. 2. Arrangements for Lighting Sign.

The Hauck Kerosene Torch.

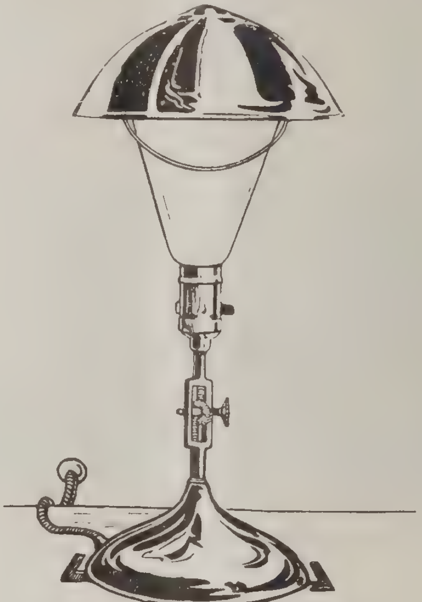
A torch designed to use kerosene has recently been placed on the market by the Hauck Mfg. Co., of Brooklyn, N. Y. A feature for which special claims are made is the construction of the bronze burner. The oil passageways are especially large and so arranged that only one plug has to be unscrewed in order to clean the whole burner instantly. Also by means of a special oil regulating valve, the flame can be adjusted to any size from 8 inches long by 1 inch in diameter to the finest point.

Since kerosene contains more heating units than the average gasoline, the temperature obtained with this torch is said to be higher than that of the gasoline torch. This makes the kerosene torch especially suitable for brazing and soldering heavy cables, armature repair work, burning off insulation, soldering battery plugs. It is also claimed that strong wind or cold weather will not effect the flame in any way and it is therefore especially recommended to linemen and electricians. The torch is also furnished in connection with a light furnace for melting solder and heating soldering coppers.

A New Kerosene Torch.

The Leindorf Portable Lamp.

The accompanying illustration shows a design of portable lamp made by the Leindorf Electric Light Co., Inc., 220 West 42nd street, New York City. The lamp is designed for maximum utility and protects the eyes from glare. Its low cost makes it an attractive proposition for electrical dealers and central station new business managers, as its applications and use in the home and office are numerous.



The Leindorf Portable Lamp.

A New Westinghouse Electric Motor.

The Westinghouse Electric & Mfg. Company has recently placed on the market a new line of large slip-ring induction motors for continuous service, such as driving pumps, blowers, compressors, hoists, and other machinery requiring heavy torque at starting. One of the chief characteristics of these motors is strength. The frame is massive, the bearings and shafts extra large, and the windings are securely braced against vibration. The bearings are dust-proof and rest on three machined seats, a construction that has been found best practice in steel mill service.

Fig. 1. The Westinghouse Slip Ring Induction Motor.

FIG. 2. STATOR AND COILS OF MOTOR.

All coils are form wound and completely insulated to ground before being placed in the slots. The stator slots are straight open; those of the rotor having an overhanging lip which assist in holding the coils in place, but the coils can be removed and replaced without bending as readily as with straight open slots. The shaft can be removed without disturbing rotor winding, and the bearing shell may be removed and replaced without taking off the lower half of the bearing bracket.

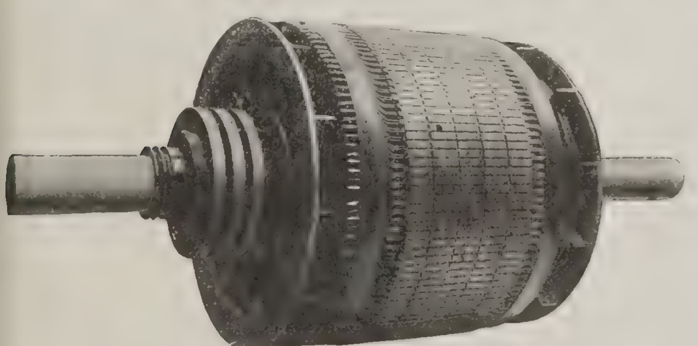


FIG. 3. ARMATURE OF WESTINGHOUSE SLIP RING MOTOR.

New Telephone System in China.

That the telephone industry in China is developing rapidly is indicated by several modern telephone installations that have been recently completed in various cities. The Chinese have realized the advantages of the telephone for government as well as commercial uses and are beginning to recognize that telephone systems, properly designed and managed, will yield profits. At Changsha a new and modern system was opened last July with American equipment of the central-battery type, with lamp signals. It has a present capacity of 1,000 local lines and 40 toll or long-distance lines, and is arranged for an ultimate capacity of 3,000 lines, equipment for which may be added as desired.

Electrical Construction News

This department is maintained for the benefit of contractors, dealers, manufacturers and consulting engineers.

GEORGIA AND FLORIDA.

TOCCOA, GA. Plans are under consideration for the installation of an electric light plant.

SELLSMERE, FLA. It is understood that plans are under way for the installation of an electric light plant to be operated by artesian well power.

KENTUCKY.

BRANDENBURG. An electric light franchise has been purchased by W. D. Coleman, who plans to install a street lighting system.

ROCKPORT. The Rockport Coal Company has been granted a franchise to construct an electric light plant.

LOUISIANA.

AMITE. The Central Light & Power Company contemplates improvements and installation of oil engine in its power house.

WINNFIELD. The Johnson Ice & Light Company plans to build an electric light plant. J. M. Johnson is president.

NORTH AND SOUTH CAROLINA.

GREENSBORO, N. C. The Revolution Cotton Mills expect to make extensions to its mills and install electric motors to take power from the Southern Power Company.

LAGRANGE, N. C. The city is planning to erect an electric light plant.

ALLENDALE, S. C. A bond issue of $65,000 has been voted for the construction of an electric light plant and water works system.

CHARLESTON, S. C. The Charleston Consolidated Railway & Lighting Company plans to make extensions to its street railway system from the Navy Yard to North Charleston.

MANNING, S. C. The Manning Light & Ice Company has been incorporated with a capital of $15,000, by L. H. Harvin and S. O'Brien.

WHITEVILLE. It is understood that a franchise has been granted H. D. MacNair to construct an electric light plant in Whiteville.

TENNESSEE.

DYERSBURG. The city is planning to purchase a motor driven centrifugal pump of one million gallons capacity, as well as smaller motor driven pumps. S. R. Blakeman is superintendent of the water and light plant.

EMBREEVILLE. The Tennessee Eastern Electric Company of Johnson City has erected a transmission line from Jonesboro to Embreeville and proposes to furnish energy to operate zinc mines.

KNOXVILLE. It is understood that the present ornamental lighting system on Jay Street of Knoxville will be replaced with nitrogen filled lamps.

TEXAS.

DALLAS. The Texas Power & Light Company of Dallas is contemplating improvements in connection with its various properties. A plant will be constructed at Ferris and at Waco, Texas, and transmission lines built. It is understood that an expenditure of about one million dolars is to be made.

PERSONAL AND INDUSTRIAL ITEMS.

MR. C. H. BROWNARD, formerly with the Baltimore Electrical Company of Atlanta, has recently been appointed Southern representative of the Hart and Hegeman Mfg. Co., of Hartford, Conn., which company is also selling agents for the H. T. Paiste Co., manufacturers of wiring devices. Mr. Broward will maintain headquarters at Atlanta and be reached by addressing P. O. Box 203. The territory which he will cover includes the states of Georgia, Florida, Alabama, Mississippi and Tennessee, calling on the entire electrical trade and cooperating with Southern jobbers.

MR. E. L. CALLAHAN, for six years manager of the New Business Department of H. M. Byllesby & Company of Chicago, and director of the new business activities of the thirty-five properties under its management, has resigned that position to become district manager of the Westinghouse Lamp Company with offices and headquarters at Chicago. Mr. Callahan took up his new duties February 1.

MR. F. E. WATTS, formerly of the advertising staff of the Electrical World, has been appointed district manager of the Hart Manufacturing Co., of Hartford, Conn., with headquarters at 203 Broadway, New York City.

CHARLES L. BENJAMIN for the past eight years advertising manager of the Cutler-Hammer Mfg. Co., of Milwaukee, Wis., has resigned

and acquired an interest in the Klau Van Petersom-Dunlap Inc., advertising agency of Milwaukee. Mr. Benjamin is well known among the advertising men of the country as one of the foremost authorities on technical trade paper advertising. He is a disciple of George P. Rowell, the most famous advertising man of his day, and when in 1888 Mr. Rowell founded Printers' Ink "the little schoolmaster in the art of advertising," he selected Mr Benjamin to edit it.

Mr. Benjamin's success as editor of Printer's Ink led the Century Company, publishers of the Century Magazine, the Century Dictionary and many book publications, to place him in charge of their general publicity work. Here he had the advantage of the advice and criticism of the late Richard Watson Gilder, the famous editor of the Century, the art editors of the magazine and the late Theodore L. De Vinne, who has been called the greatest American printer since Franklin's time.

The outbreak of the Spanish war in 1898 found Mr. Benjamin conducting an advertising service of his own in Brooklyn. But when the call for troops came, he enlisted, serving with Troop "C" of Brooklyn in the Porto Rican campaign. Immediately after the war he went to Cuba in the government service and when the American troops were withdrawn from the island several years later, he was retained by the Cuban government to supervise the instruction of the new Cuban employes. At the conclusion of this service, he returned to active advertising work in New York, where he performed valuable service for the Central railroad of New Jersey, as editor of the Suburbanite, a monthly magazine which achieved remarkable results in stimulating migration from the crowded apartment houses of New York to the pleasant suburban towns along the line of the Jersey Central.

Mr. Benjamin is a past president of the Advertisers' club of Milwaukee and has been much in demand as a speaker at important gatherings of advertising men and at business conventions. He is the eldest son of Charles F. Benjamin, a prominent lawyer of Washington, D. C., who had the distinction of serving as private secretary to Edwin M. Stanton, Linclon's famous secretary of war. A brother, F. J. Benjamin, is advertising manager of the Milwaukee-Western Fuel Company.

MR. A. H. SHIRLEY, formerly a member of the sales organization or the Turner Electric Company of Birmingham, Ala., has been appointed Georgia representative of the W. E. Carter Electric Co., of Atlanta. The latter company has recently been made general electric distributor for the state of Georgia.

Mr. H. C. Spaulding, until recently manager of the advertising department of the Society for Electrical Development, has joined the Frank Presbrey Co., of 456 Fourth Ave., for which company he will organize an electrical service department.

The P. J. Electric Heating Company of 332 S. LaSalle St., Chicago, Ill., is marketing a toaster which is causing considerable interest among the trade. This is due to its light construction and inexpensiveness. It comes to a red hot heat in four seconds after it is placed in circuit. The 440 watt heating element is composed of five 6-inch by 0.125-inch "Nichrome" resistance wire of 26 gauge helices. The extension cord is a new code flexible silk with a two-piece attachment plug. The heating element is mounted upon a composition which is ½-inch thick and which acts as a non-conductor of heat. The frame of this toaster is made of cold rolled steel and finished in copper, nickel and brushed brass. Two pieces of bread will easily fit this toaster at one time.

MR. H. W. COPE, formerly assistant manager of the Industrial and power department of the Westinghouse Electric and Mfg. Co., at East Pittsburgh, has been appointed director of the company's exhibit for the Panama-Pacific International Exposition to be held in San Francisco in 1915, and is now located in San Francisco, giving his personal attention to the work. Mr. Cope was born in North Vernon, Ind., and is a graduate of Perdue University of that state. Prior to his attending the University he was engaged in electrical construction and sales work. In September, 1898, following his graduation, he became associated with the Westinghouse Electric & Mfg. Co., at East Pittsburgh with which company he has remainded ever since. Mr. Cope took the apprenticeship course and was engaged in the engineering department in connection with the design of alternating current switchboards, layout of power houses and sub-stations; and in 1905 was made the head of the A. C. correcpondence department.

THOMAS B. RHODES, for several years associated with the United Electric Engineering Corporation, has accepted a position with the Sangamo Electric Company of Springfield, Ill. Mr. Rhodes will begin by having charge of the company's business with the various electric light and power syndicates and will be located at the New York office, 50 Church street.

MR. H. H. SEABROOK, formerly district manager of the Westinghouse Electric & Mfg. Co., in Baltimore, on January 1st, 1915, assumed the position of district manager in Philadelphia, and due to the consolidation of territories, the Philadelphia office will hereafter embrace that previously covered by the Philadelphia and Baltimore offices. Mr. Seabrook succeeds Mr. J. J. Gibson who becomes manager of the detail and supply department at East Pittsburgh.

What to Buy and Where--Told in Catalogues Just Issued

The following catalogs have just been published by the companies named and can be secured without charge by writing to the addresses given. Many of these catalogs contain data you will value.

No.	Name	Company
37	Western Electric 1915 Fans	Western Electric Co., New York City.
	Jandus Fans—1915	Adams-Bagnall Electric Co., Cleveland, Ohio.
32	Self Cooled Motor Propeller Fan	Ilg Electric Ventilating Co., Chicago, Ill.
	Eck Fans	Eck Dynamo and Motor Co., Belleville, N. J.
	Dayton Ceiling and Desk Fans	Dayton Fan and Motor Co., Dayton, Ohio.
	General Electric 1915 Fans	General Electric Co., Schenctady, N. Y.
	Westinghouse Electric Fans	Westinghouse Electric and Mfg. Co., Pittsburgh, Pa.
	Diehl Electric Fans 1915	Diehl Mfg. Co., Elizabeth, N. J.
	Emerson Fans 1915	Emerson Electric Mfg. Co., St. Louis, Mo.
	Electrical Specialties	Chelten Electric Co., Philadelphia, Pa.
	Booklet on Wiring Small Houses	Pittsburgh Electric Specialties Co., 927 French St., Pittsburgh, Pa.
	Automatic Motor Starters	Cutler Hammer Co., Milwaukee, Wis.
	Electricity in the Home	Society for Electrical Development, 39 W. 39th street, New York.
	Insulation	The Continental Fibre Co., Newark, N. J.
567	Electrical Construction Supplies	Fletcher Mfg. Co., Second & Canal Sts., Dayton, Ohio.
20	Storage Battery Lighting Sets, Power Plants, Lighting Fixtures, etc.	Main Electric Mfg. Co., Pittsburgh, Pa.
202	H Induction motors	Fairbanks Morse and Co., Chicago, Ill.
210	Internal Starter Motors	Fairbanks Morse and Co., Chicago, Ill.
1091	Governor for Regulation of Presure in Air Brake Equip.	Allis Chalmers Co., Milwaukee, Wis.
1090	Motor Generator Sets	Allis Chalmers Co., Milwaukee, Wis.
1088	Distributing Transformers	Allis Chalmers Co., Milwaukee, Wis.
1089	Reversing Motor Planer Drive	Allis Chalmers Co., Milwaukee, Wis.
111	Steel Frame D. C. Generators	Robbins and Myers Co., Springfield, Ohio.
	Steel Transmission Line Structures	Archbold Brady Co., Syracuse, N. Y.
	Electric Trucks in Brewery Service	General Vehicle Co., Long Island City, N. Y.
	Electric Coal Trucks	General Vehicle Co., Long Island City, N. Y.
48702	Fabroil Gears	General Electric Co., Schnectady, N. Y.
15	High Tension Indoor Equipment	Delta Star Co., Chicago, Ill.
8	Pelton Water Wheels	Pelton Water Wheel Co., San Francisco, Calif.
	Magnetic Switches	Cutler-Hammer Mfg. Co., Milwaukee, Wis.
28	Motor, Steam Turbine and Belt Driven Fans	L. J. Wing Mfg. Co., 352 West 13th St., New York City.
24	Electrically Driven Tools	James Clark, Jr., Electric Co., Louisville, Ky.
	Lincoln Electric Charger	Lincoln Electric Co., Cleveland, Ohio.

MISS GRACE T. HADLEY, formerly assistant editor of the Popular Electricity and the World's Advance, has joined the staff of the Society for Electrical Development. Miss Hadley will be in charge of the department, "Electric Service in the Home." While with Popular Electricity, Miss Hadley developed a department, "Electrical Interests of Women," dealing with all of the practical applications of electricity in the home.

THE TRUMBULL ELECTRIC MFG. CO., of Plainville, Conn., has opened a Western office at 595 Mission Street, San Francisco, Cal. This office will be in charge of W. P. Naser who has represented the company in the West for several years. A stock of supplies will be carried sufficiently large to take care of the coast trade.

THE DELTA STAR ELECTRIC COMPANY, Chicago, Ill., is distributing bulletin No. 15, devoted to high tension indoor equipment. This bulletin, which comprises 80 pages, has a total of 188 illustrations, and lists approximately 1200 different types of switches, fuse mountings, choke coils, etc. Ten pages are devoted to technical data of interest to engineers, who can secure copy of this publication upon application.

THE WAGNER ELECTRIC MANUFACTURING COMPANY of St. Louis, Mo., announces the opening of a sales office on January 1st, in the Pioneer Building, Saint Paul, Minnesota, in charge of Mr. C. Kirk Hillman, who for some time has been identified with the sales of Wagner apparatus in this territory.

THE CUTLER-HAMMER MFG. CO., Milwaukee, had an interesting exhibit at the New York Automobile Show which opened January 2nd. The principal device shown was the electric gear shift for gasoline automobiles, which was mounted on a Winton transmission. The operation of this device, which elimnates the hand-shifting of gears, is controlled by push buttons mounted in the center of the steering wheel. The Winton six is one of the 1915 cars to be furnished with electric gear shift. C-H single button push-and-pull automobile lighting switches were shown in various combinations for the control and dimming of automobile lights. Cutler-Hammer Pyroplax fireproof insulating material is also shown and samples of such parts as radiator caps, switch sub-bases, fuse boxes, motor terminal blocks, etc., are mounted on a display board. A similar exhibit will be made at the coming Chicago automobile show.

BOOK REVIEW.

PUMPING BY COMPRESSED AIR. By Edmond M. Ivens. Published by John Wiley and Sons, 432 Fourth Ave., New York City. 256 pages. Price, $3.00.

At some time during the experience of a plant operator in the South and other sections as well, the design and installation of an air lift for pumping water has been a cut and try problem. To such a reader and to others who may be operating air lifts that seem unsatisfactory, the above mentioned work will appeal. It represents the work of an engineer in search of information on the subject for practical purposes and on that account contains a mass of useful data for design and installation purposes. The book is also an authority on the use of compressed air, the laws governing same and operation of compressors.

The contents of the book is arranged under the following headings: Pumping Water by Direct Action Through Pistons. The Displacement Pump, Return Air System. The Air Lift. Submergence. Velocities. Central Pipe (Open End) System. Commercial Systems. Compression Generalities. The Air Card and Air Compressor Efficiency. The Compressor. Flow of Compressed Air in Pipes. Flow of Water in Pipes. The Installation of a Pneumatic Pumping Plant.

Alphabetical Index to Advertisers

This Issue 9,500 Copies

ELECTRICAL ENGINEERING

Vol. 47. MARCH, 1915. No. 3.

The Lock 12 Development of the Alabama Power Company

BY W. E. MITCHELL, ELECTRICAL ENGINEER AND OPERATING MANAGER, ALABAMA POWER COMPANY.

IN the January, 1914, issue of *Electrical Engineering* an article was published giving in a general way, the engineering features of the developments then completed and under way by the Alabama Power Company in the state of Alabama. The Lock 12 development of the company has been completed and placed in operation since that time and what follows is descriptive of the construction and engineering details.

The site of the Lock 12 development on the Coosa River, is in the central part of Alabama and the dam is one of a series of dams planned by the U. S. Government in conjunction with locks to make the Coosa River navigable. The Lock 12 dam is built of cyclopean concrete. It is 1,563 feet long from shore to shore and the top of the spillway gates are 72 feet above the water in the tail race. The spillways are in 26 sections, each section being separated by concrete piers on top of which is a track for a special traveling hoist to be used in raising and lowering the spillway gates. These gates are 14 feet high, 26 feet wide and slide up and down in vertical grooves in the spillway piers. They can be operated by either an electric hoist or by a steam hoist. Motive power to operate the gates is transmitted from the hoist through a wabbler connection to a shaft and gears operating a horizontal shaft that winds and unwinds flexible flat steel cables. Two of these cables are attached to each gate and each gate raises and lowers independently of the others. The hoist can be moved along the track the full length of the spillway and coupled to any gate. This allows the level of the pond to be regulated by passing the surplus water through the gates during the high water and holding back the required amount during low water periods.

The power house is located near the west end of the dam and is built into the lower side of it. The main power house entrance is from the top of the dam. In front of the power house are the penstock gates, of which there are two for each turbine. These gates are operated by hydraulic cylinders mounted directly over them and are direct connected to the hydraulic piston rods. The pistons are operated by oil pressure from the governor pressure pumps. Under normal conditions these gates are left open and held open by mechanical devices, thereby taking their weight off of the cylinders and relieving the governor pumps of this work. If it is necessary to close the gates in emergency the mechanical devices can be tripped and the oil in the cylinders by-passed from the bottom to the top of the pistons, letting the gates down quickly but without any slack.

FIG. 1. THE LOCK 12 DEVELOPMENT OF THE ALABAMA POWER COMPANY ON THE COOSA RIVER.

In front of the power house and running the full length of it is a Gantry crane running on tracks laid on top of the dam. The crane overhangs the water in the forebay so that it can handle the racks and screens in front of the penstock gates. It also serves to pick up freight and material from the barge which carries freight from the company's freight depot at Ida, about 12 miles up the river. The barge is towed back and forth by a gasoline tug provided for that purpose. Since the completion of the construction work, when the construction railroad was taken up, this is the only way of getting material to the plant as the nearest railroad depot available to a team is about 14 miles distant.

At the west end of the power house there is a freight entrance. Inside the building there is a crane to pick up material left by the Gantry crane and lower it to the main

generator floor. Next to the freight entrance is an entrance for the public. This entrance leads into a hall way from which stairs lead to the different floors.

The lower floor is occupied by the generators, governors, governor pumps, an overhead traveling crane and other auxiliary apparatus to be described later. The generator room crane has two hoists, one of 100 tons, the other of 10 tons capacity. It runs the entire length of the building. At the west end of the building there is a small basement in which is located a compressed air storage tank, an oil filter press and drier, and storage oil tanks for transil oil and bearing oil.

On the north side of the generator room is the switchboard gallery for the switchboard, low tension 6,600-volt bus structure and oil switches, station power and lighting transformers, a motor generator exciter, battery charging set, telephone booth and lavatory and locker rooms. This gallery is directly over the lower slope of the dam and elevated above the generators, giving a clear view of all the generators from the switchboard. Directly above the switchboard gallery, and of the same width, is the transformer room which is separated from the generator room by a brick partition. Between this floor and the switchboard gallery is a mezzanine floor which is occupied by the superintendent's office and a store room.

Located on the top floor are the 110,000-volt oil switches and buses, storage battery room and oil tanks for bearing and transil oil. The part of this room that is above the transformer room is open to allow the high tension leads from the step-up transformers to be brought up to the 110,000-volt bus structure and oil switches. The space on

Fig. 3. One of Four 13,500 Kva. 6,600 Volt Generators Installed.

the roof is occupied by lightning arresters and transmission line terminals. Three high tension circuits enter the building through roof bushings and connect to the high tension buses through oil switches.

At present there are four 13,500 Kva., 100 revolutions per minute Westinghouse vertical generators installed and operating at 6,600 volt, 60 cycles, with provision made for two more units in the future. Each machine has its own direct connected exciter. These exciters have a capacity of 150 Kw. at 250 volts. Besides these exciters there is one 150 Kw. 250 volt spare exciter driven by a 440 volt 225 horsepower induction motor. This exciter may be used on any one of the four generators.

The generators are driven by 17,500 horsepower Francis reaction single runner turbines, built by the I. P. Morris Company. Water is brought to each turbine through rotating vanes from a snail shaped scroll casing which curves around the periphery of the water wheel. Water from the head gates enters one end of this scroll casing through two short concrete tunnels. These turbines pass approximately 2,500 cubic feet of water per second when the generator is operating at its rated capacity.

Speed is controlled by Lombard governors having a capacity of 250,000 foot pounds at 200 pounds pressure. The minimum time element of course is two seconds. The fly wheel effect of the generator rotor alone is 12,500,000 foot pounds. The control mechanism for the governors is enclosed in a metal casing, thus practically eliminating dust

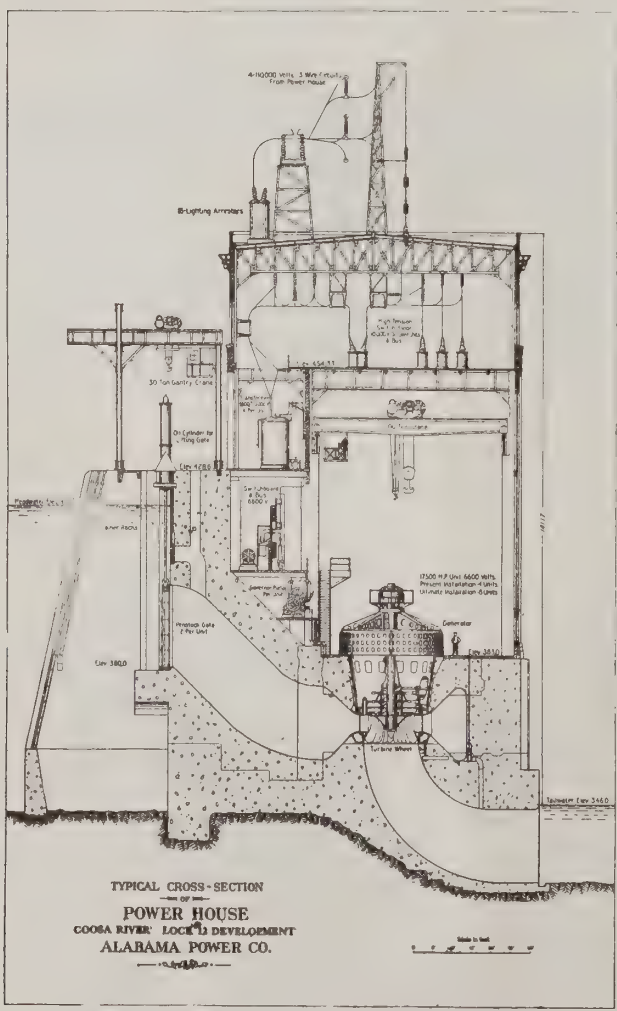


Fig. 2. Section of Lock 12 Station.

Fig. 4. View of Lock 12 Dam Showing Track and Hoists at Right End for Handling Gates.

FIG. 5. STRUCTURE ON ROOF OF LOCK 12 STATION SHOWING LINES LEAVING STATION AND LIGHTNING ARRESTORS.

and dirt from the parts. Access is had to these parts through doors at the front and back. On the front of the casing are mounted a speed indicator, oil pressure gauge, discharge oil pressure guage, a gate opening indicator, a handle for setting the gate opening limit and a hand speed control. The speed is also controlled by a reversible motor operated from the switchboard. The governor fly balls are driven through gears and shafting operating from the generator shaft. Power from the governor is delivered to the guide vanes of each turbine through two horizontal hydraulic cylinders or servor motors which rotate a collar around the generator shaft, the motion being transmitted from the collar to the vanes, of which there are twenty on each machine, by a link and rocker arm for each vane. Individual 8 x 10 inch Deane triplex oil pumps maintain pressure for the governor mechanism. These pumps are geared to and driven by 35 horsepower, 440 volt, 900 revolutions per minute slip ring induction motors which are controlled by automatic starters.

The entire weight of the turbine and rotating part of the generator and exciter is supported by 42 inch Kingsbury bearings which are placed between the generator and exciter. Oil for these bearings flows by gravity from two oil tanks on the top floor of the building to a large pan surrounding the bearing. When the oil leaves the bearings

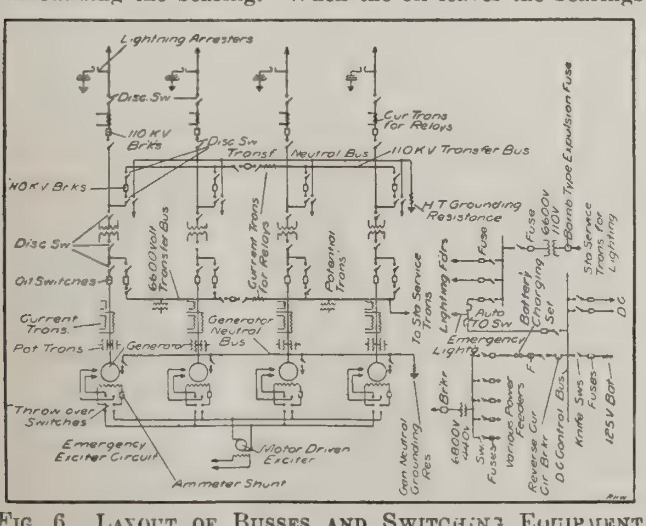


FIG. 6. LAYOUT OF BUSSES AND SWITCHING EQUIPMENT FOR LOCK 12 DEVELOPMENT.

FIG. 7. SWITCHBOARD GALLERY SHOWING LOW TENSION BUS STRUCTURE AND OIL SWITCHES.

it is discharged by gravity into two tanks in the basement where it is cooled by water circulating in cooling coils therein. Two triplex pumps pump the oil from these tanks back to the tanks on the top floor whence it flows through the bearing again. These pumps are geared to and driven by a 5 horsepower, 440 volt, 1,150 revolutions per minute Westinghouse induction motors. Alignment of the big generator shaft is maintained by water cooled lignum vitae guide bearings mounted between the generator and water turbine.

A small Ingersoll-Rand air compressor, belt driven by a 10 horsepower, 440 volt Westinghouse induction motor, supplies air pressure with which to stop the machines. The

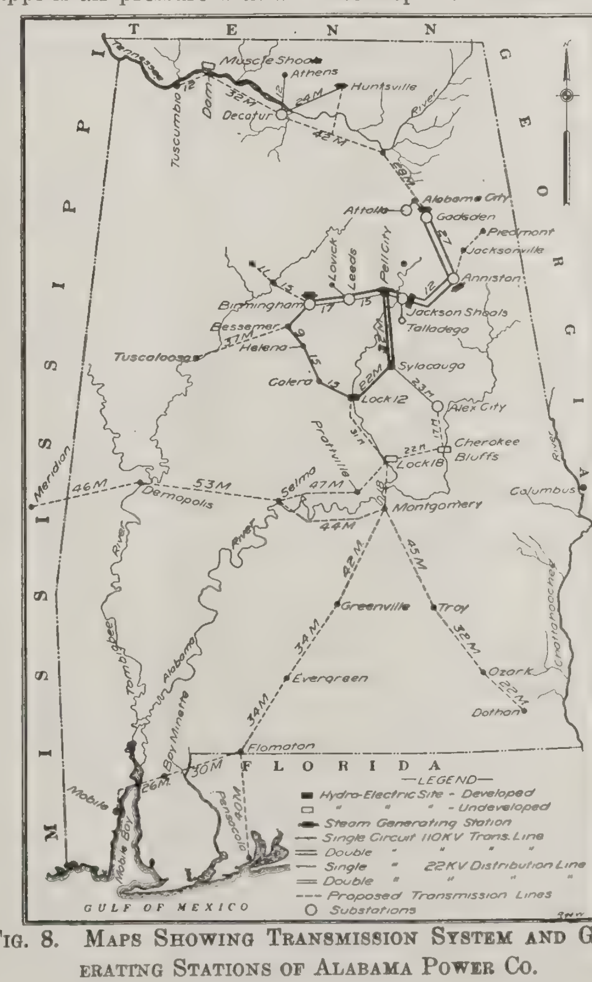


FIG. 8. MAPS SHOWING TRANSMISSION SYSTEM AND GENERATING STATIONS OF ALABAMA POWER CO.

brakes are applied to an iron band on the under side of the revolving field spiders.

The switchboard consists of twelve slate panels with a swinging bracket on one end on which are mounted a synchroscope, an indicating voltmeter for the 6,600-volt bus, an indicating voltmeter for showing generator voltage and a frequency indicator. One of the panels is for the battery charging equipment, including battery and charging set ammeters, a direct connected voltmeter and the necessary switches; one panel for the station power and light circuits; one panel for the over voltage cut-out relays, one for each generator, and the station clock; one panel for the high and low tension bus tie switch controls, a voltmeter for the direct connected exciters, a voltmeter for the motor exciter, and the motor exciter field switch and rheostat control; and two panels for each of the four generators. On each pair of generator panels are mounted a Tirell regulator, a curve drawing wattmeter, an integrating wattmeter, an alternating current and direct current ammeter, a power factor indicator, an exciter field switch, an exciter field rheostat control, control for a rheostat in series with the alternating current coil of the regulator for raising and lowering the voltage to be held by the regulator, and two low tension and two high tension oil switch controls. An alarm bell to give warning when an oil switch trips out and definite time limit relays for each generator oil switch, for each transmission line oil switch, and for the high and low tension bus tie switches, are also mounted on the switchboard. Dummy buses, made of copper strips, are laid out on the front of the board showing the relative positions of the high and low tension buses, oil switches and disconnecting switches. The power for operating oil switches and pilot lamps is supplied by a sixty cell storage battery furnished by the Electric Storage Battery Company.

In this installation there are no rheostats in series with the generator fields, voltage regulation being entirely taken care of by varying the resistance in the exciter field.

The 6,600-volt buses are directly back of the switchboard and enclosed in brick cells. There are two of these buses, two machines being connected to each bus by cables run in conduit imbedded in the concrete foundations. A bus tie switch is provided and arranged for paralleling the two buses. The 110,000-volt buses are similarly arranged and are constructed of 1½ inch galvanized pipe painted with bronze paint after being installed.

Power for the auxiliary apparatus is supplied by three single phase 200 Kva., 6,600-440 volt General Electric transformers connected delta-delta. Lights are furnished by one 50 Kva., 6,600-110 volt transformer. These transformers are all oil cooled. Provision is made for emergency lights which are automatically changed through a double throw automatic switch to burn from the storage battery in case the alternating current power fails.

Though space is provided for four banks of step-up transformers there are at present only three banks installed. Each of these banks consists of three 4,500 Kva., 6,600, 13,200-63,800 volt 60 cycle, single phase Westinghouse transformers, connected delta-star to deliver 110,000 volts to the transmission lines, of which there are now three with provision for one more in the future.

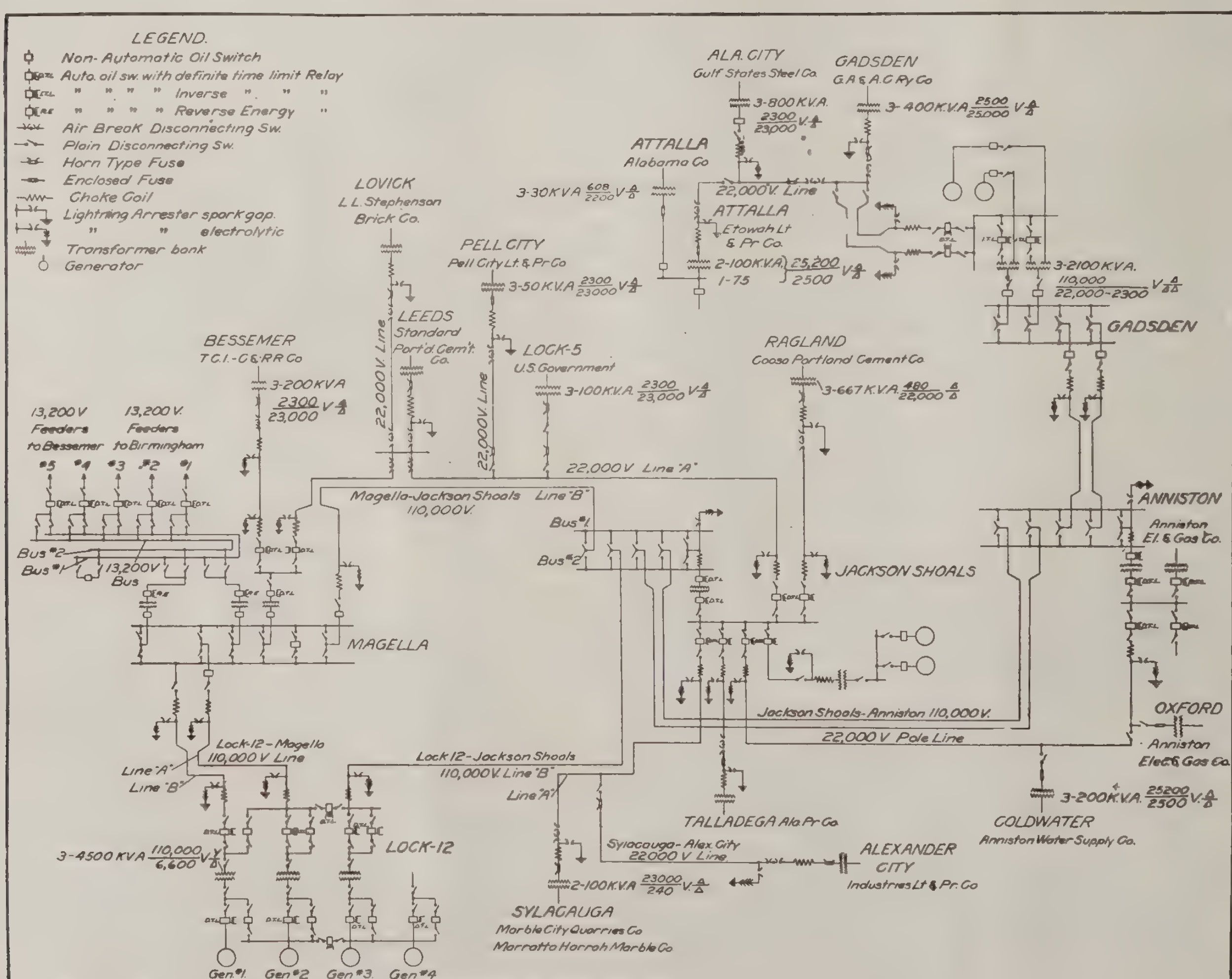


Fig. 9. Diagram Showing Generating Station and Sub-station Layouts for Entire System.

Fig. 10. The Magella Substation at Birmingham, Ala.

The bus and switching arrangement is such that a generator may be conected through its bank of transformers to one of the transmission lines without going through either the high or low tension buses, or all machines and transformers may be put together on either the high or low tension buses, or on both. This possibility is shown by the "System Wiring Diagram" and was previously treated in the January, 1914, issue of *Electrical Engineering.*

All of the step-up transformers are water cooled, water being supplied by two motor driven centrifugal pumps located on the generator floor, and by gravity from an emergency tank on the bank of the river above the power house. Oil pipes run from these transformers to transil oil tanks and an oil filter press and drier in the basement where the oil may be dried. A small centrifugal pump is installed in the basement to pump the oil back into the transformers or into the oil tank from which it will run by gravity into the transformers.

From the top floor or high tension room the 110,000 volt leads go through roof bushings to the lightning arresters and outgoing lines on top of the power house. The arresters are the standard type of electrolytic arresters made by the General Electric Company. Both the high and low tension oil switches are solenoid operated switches except the low tension bus tie power house supply switches which are motor controlled. The latter are also General Electric as are the switchboard, the instruments and the regulators.

Located in a separate building on the river bank west of the power house is a machine shop. It is fitted with a lathe, shaper, drill press, band saw and emery wheel. In one end of the shop space is reserved for an ice machine yet to be installed.

The transmission lines and station layouts are best illustrated by the "System Wiring Diagram" of Fig. 9, previously mentioned, which shows the system at the present stage of development, each three phase transmission line or feeder being represented by a single line. It should be noted that all transmission lines operate at 110,000 volts, while the standard distribution voltage is 22,000 except from the Magella substation to the Birmingham Railway, Light & Power Company, where 13,200 volts is used.

The distance from Lock 12 to the Magella substation, located in a suburb of Birmingham of that name, is nearly 50 miles; from Magella to Jackson Shoals is about 50 miles; from Lock 12 to Gadsden, the end of the line, is about 100 miles, making approximately 200 miles of transmission lines, of which all except about 50 miles is duplicated. At Gadsden there is an auxiliary plant of 10,000 Kw. capacity. This plant was fully described in the January, 1914, issue of *Electrical Engineering.*

Telephone lines parallel the 110,000-volt lines to all parts of the system and to the company's office in Birmingham. Each station is also served by the Southern Bell Telephone Company.

The Lock 12 plant has peen in operation and furnishing power at 110,000 volts to all parts of the system since July 15, 1914. Previously this plant had been supplying power to part of the system temporarily at 22,000 volts since April 15, 1914. The 110,000-volt lines are insulated with six disc suspension insulators strung on steel towers. The number of towers averages about 8 to the mile. At each place where there is a sharp bend, a steep hill or a long river span strain towers are used. The insulators on the strain towers have seven instead of six discs.

The lines and apparatus have stood the test of the severe electric storms during the past summer remarkably well, and in case of interruptions caused by lightning, power has always been promptly restored.

Iron Conduit Work for Interior Wiring and Possible Fire Risks.

BY V. C. WYNNE, CONSULTING ENGINEER, ALBANY, N. Y.

Suggestions and Methods for Eliminating Fire Risks in Electrical Wiring.

The writer is a strong advocate of the general use of a complete iron conduit system for the installation of low tension interior wiring for lighting and motors in the ordinary run of buildings such as residences, offices and manufacturing plants. Such systems are much more permanent and less subject to mechanical interference than exposed or concealed open wiring. At the same time he desires to point out at least a few of the possible troubles which may occur in connection with any iron conduit system, and more particularly in those cases where the work of installation is not done in a most thorough and careful manner.

It is perhaps rather unfortunate that contractors and workmen engaged in interior electrical construction are, as a general thing, quite unfamiliar with the work of taking care of the installations after they are in use, or with the various troubles which may later occur on account of poor and careless workmanship, so that their construction work is usually done as well—or as poorly—as is found to be actually necessary, in order to pass such inspection as it may receive during installation and before final payment. In the minds of architects and owners of buildings generally, as well as in the minds of contractors and workmen of the type referred to, there seems to be a decided impression that if interior wiring is put in as an "iron conduit job," it is thereupon, and evermore thereafter, at least perfectly safe as regards fire risk, if not always otherwise satisfactory. It is therefore well for us to fully realize

some of the possible dangers from wiring installations in iron conduits, also to carefully consider the best means for avoiding any likelihood of serious trouble arising from any of the causes herein mentioned.

The sole purpose of this article is therefore to call attention to the necessity for great care to avoid fire risks. It is not intended to touch upon the question of general design for iron conduit systems or to praise any particular make or style of conduit and fittings as superior to others, or to refer to any of the various possible minor troubles and annoyances which may occur in any system other than those which may be considered as possible causes of fire. It may be well to state at the outset what is really the conclusion to which a great many years of experience in conduit work have brought the writer, namely, that there is no such thing as an *absolutely safe* wiring system for a non-fireproof building, and that the only way to finally destroy the chance of a fire being started is to remove entirely, from the proximity of the wiring, all material which could possibly support or spread combustion or which would even allow a fire to be started, outside of the conduit itself, by means of sparks freely given out or by the heating to redness of an outlet-box or section of conduit.

In concealed conduit work in absolutely fireproof construction, as with conduit buried in concrete, tile or brickwork, the conduit, wires or outlet-box might be entirely burned up or otherwise ruined by a heavy short-circuit or other cause, without the possibility of communicating a fire to the building construction, but this is by no means the case in concealed conduit work in non-fireproof buildings. In buildings of ordinary construction, having wood floor-joints with lath and plaster ceilings, and in those perhaps still more dangerous buildings which have old wooden floor-joists but whose appearance is veiled by steel ceilings either immediately under the joists or furred down to some distance below same, concealed conduit work must always be considered as a possible source of danger. Even exposed conduit work, whether in non-fireproof buildings or in so-called fireproof buildings must also always be considered as a possible cause of fire when installed in mills, factories, workshops and stores or any other places where there is light inflammable material around. When such exposed work is properly and carefully installed, however, it has a certain advantage in that its condition and its surroundings are more easily kept under observation and, in case an incipient fire should break out at any time, it would usually be noticed at once, and be more easily reached and put out than would one which started in concealed wooden floor construction, especially in construction where there is a large air space partly filled with easily inflammable wood joists and furring strips, as afforded by a hung or deeply furred-down steel, wood, or plaster ceiling.

The three final causes of fire risk most frequently met with are (1) short circuits; (2) grounds, and (3) arching; and only these will be touched upon here. Under "short circuits" reference is made only to short circuits within conduits or boxes. Short circuits occurring upon the outside of conduits or fittings are considered under (2) or "grounds."

SHORT CIRCUITS.

In the early days of iron conduit work, one of our American firms made an iron conduit lined with insulating material, and this firm used to advertise very strongly in favor of its lined conduit as against the unlined conduit of other makes. Printed illustrations of "burn-outs" in its lined conduits and in unlined conduits of other make were used to show how easy it was to blow a hole through an unlined conduit and how very difficult it was to do this in the case of its own lined conduits. While there is certainly very much less likelihood of any wire coming into contact with the inside surface of the lined conduit than of the unlined conduit, the advantage in this respect is usually not considered sufficient to warrant the use of the more expensive lined conduit for general work, so that unlined conduit has come to be standard and the firm in question now regularly makes and offers for sale a good grade of unlined conduit.

We still occasionally have short-circuits in iron conduits, but there is little excuse for such occurring inside of any run of conduit, provided the wiring is installed with even the limited care found in ordinary commercial work. If a short circuit does occur within the conduit, by reason of using wire with poor insulation, or with insulation damaged by pulling the wires through a long and difficult run of conduit, so as to bring two or more bare wires into contact with each other, or to bring two or more wires into contact with the conduit which in turn becomes or is already grounded to some wire of an opposite polarity; there is seldom a sufficiently heavy instantaneous flow of current to puncture the wall of the conduit provided the wires of the circuit are properly fused with fuses of the limited capacity required for the service, or are protected by means of a satisfactory automatic circuit breaker.

Short circuits are, unfortunately, not so very infrequent in switch boxes and outlet-boxes, where wires have been bared and joints been carelessly made and taped, so that the contact takes place between the wires and the outlet-box or the end of the conduit. In most of such cases, the trouble occurs in a small branch circuit which is—or ought to be—protected by means of 6-ampere fuses or other fuses of small capacity, so that the short circuit seldom does anything more serious than to put the circuit itself out of commission.

The remedy for such trouble is evidently to use wire of good commercial grade; to use conduits of ample size and with smooth interior finish; to avoid having unduly long runs of conduit or an excessive number of turns in any run; to use care and judgment in the installation of wiring; to avoid the use of unduly small outlet or switch boxes, in which pressure must necessarily be brought against the crowded wires or joints; to pay particular attention to the proper fusing of all circuits and to the testing of all circuits after installation, also to the inspection of outlets, bushings, and switch boxes and of the wiring conditions at such points.

As a general rule a short circuit between wires within a conduit or outlet-box will show itself at once or will develop within a short time after the completion of the installation and it is scarcely likely to become a cause of fire except in extreme cases where the circuit concerned is heavy and where there are other faults of design or installation, such as the use of too heavy fuses, too slow circuit-breakers, or too small wires.

The Underwriters are well aware of the possible danger of fire being started from a short circuit inside of iron conduits and they very properly object to incoming service wires being installed in conduit concealed from view between the actual point of entrance and the point where the service fuse-box is placed (unless when fully buried in

concrete or brick work), and require the service fuses to be placed actually at the point of entrance wherever practicable. They also usually require or should require, that feeders from an outside source be protected by suitable fuses or circuit-breakers at the nearest convenient point of distribution outside of the building, or at the switchboard when the building is fed directly from a powerhouse or substation.

Judging from the writer's own experience, the likelihood of a fire being directly communicated to adjacent wood work by a conduit or outlet-box, due to the actual heating of the metal on account of a short circuit within the pipe of outlet-box is, under ordinary conditions of installation, rather remote. There is always great chance for a fire to be started by sparks of metal or of burning insulation which may be thrown out from openings in any outlet-box at time of short circuit, in either concealed or exposed conduit work, if there happens to be any accumulation of lint, sawdust, shavings, or other inflammable material within reach of such sparks, and it therefore is positively necessary to see to it that there are not any loose joints or open holes left in any boxes. The ordinary electrical construction man is frequently very careless in this respect, for he generally considers it merely a matter of inspection and not a fundamental necessity. For this reason any outlet-boxes made with a lot of unnecessary openings, or with makeshift device for making openings to suit and possible future requirement, are to be looked upon at least with suspicion and their installation should be watched with particular care.

The next section of this article will take up fire risk from grounds due to short circuit or arcing.

Practical Methods for Laying Out and Building Transmission Lines

BY E. B. HOOK, JR., SUPERINTENDENT OF CONSTRUCTION, GEORGIA RAILWAY AND POWER COMPANY.

Before setting, each pole shall have its top double beveled for a rain shed, commonly called roofing. Knots should be trimmed smooth and the cross arm gains cut 1.0 inch deep. When practical, the cross arms may be put on before the poles are set, and should be so attached that they are parallel with the roof, that is, the poles when set should have the ridge on top of the poles at right angles to the line. All gains, roofs, knot holes and other abrasions should receive a thorough coating of some good preservative when other than creosoted poles are used.

There are a number of methods used for erecting poles. The most common perhaps for light or medium weight poles of average length is to raise them with pike poles as shown in Fig. 1. This method usually requires from six to twelve men according to size and weight of the pole. The writer's experience has shown that where ten men are used for piking Class "A" 40 foot chestnut poles, they can set an average of 40 poles per day of nine hours, which is a very good day's work. The usual method for setting heavy poles above 40 feet in length is the "gin-pole" method. This is a rather slow, complicated process employing a heavy set of triple block tackle, numerous guys on the "gin-pole" and some power on the fall line such as a team of mules, or a crew of men aside from the ones handling the pole to be set. The erection of eight to twelve poles a day by this method is considered very good.

Another scheme was used for setting the poles on the line under discussion which proved to be a great time saver, thus materially reducing the installation labor cost for the construction of the line. The poles were first hauled from the railroad site and distributed along the line with high-wheel pole wagons and "snaked" into position with ox teams, as shown in Figs. 2 and 3. One lineman and two helpers were used to gain the poles by the use of a light template. With the assistance of a small wrought iron yoke and two light lever jacks, they raised the top of the pole a couple feet off the ground and assemble the wishbone cross arm, telephone arm and ground line bayonet. The pole is then ready to place in the 7 foot hole already prepared for it by the digging crew. The erection gang included a foreman, twelve men and a mule team and driver. The men lift the top of the pole and place under it a mule support or "dead man" as they are usually called. Two side guys consisting of small double-block tackle and 3/4 inch rope are then fastened about 15 feet from the top end of the pole and anchored by driving digging bars in the ground some 50 feet on either side of the pole. The fall lines of these tackles are handled by two men, one to each line, and the pole is readily swayed to either side or made to ride in a vertical plane as it is being raised. A hoisting cable of 5/8 inch steel hoisting rope is attached to the top of the pole and passed over a 15 foot, 2 by 4 inch oak scantling placed on end just beyond the hole at the butt of the pole. A set of 10 inch triple steel blocks and 1 inch Manilla rope is fastened to the hoisting cable and anchored to the preceeding pole. Figure 4 shows the apparatus assembled and the different stages in erecting a pole. Power is supplied to the hoisting cable by hitching a pair of mules to the fall line, this line being guided in any direction by means of a stout snatch block. The foreman of the gang

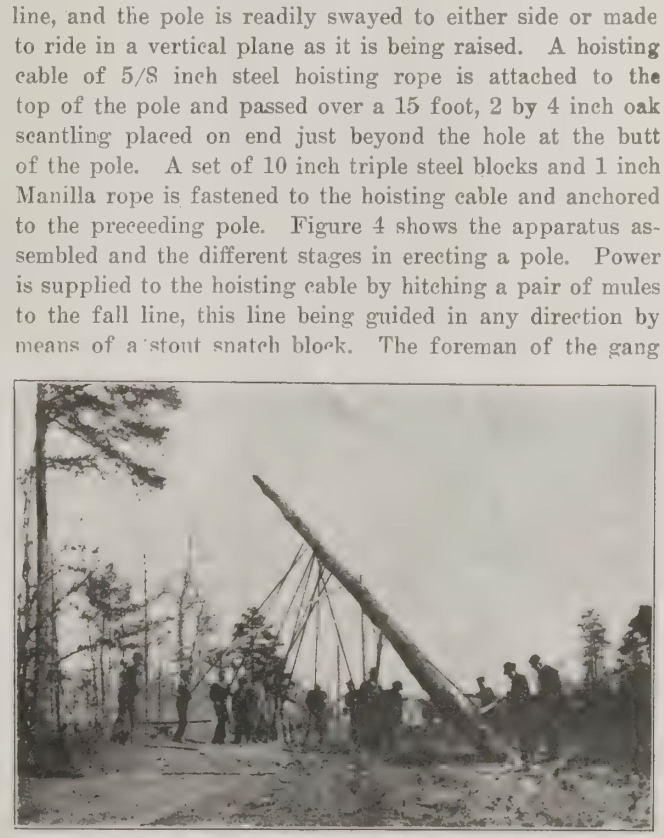


FIG. 1. METHOD OF RAISING TRANSMISSION LINE POLES WITH PIKE POLES.

Note: This article is continued from the February issue.

Figs. 2 and 3. Mule and Ox Teams With High Wheel Pole Wagons for Handling Poles During Construction of Line.

stands immediately in line with two poles already set, lines up the rigging, giving the mule driver word to start, and directs the handling of the side guys as the pole is being erected.

The angle supplied by the 15 ft. support for the hoisting cable gives the initial lift as the fall line is pulled taut, and falls clear of the rigging when the pole is high enough. Illustration No. 4 of Fig. 4 shows the hoisting cable holding the weight of the pole with the side guys in play. As the pole approaches a perpendicular position, it gradually slips into the hole and is ready for tamping. A lineman is seen in illustration No. 6 taking down the rigging when the gang is ready for the next pole. By use of this scheme, a construction crew in one day of nine working hours, erected 52 creosoted 50 ft. poles, which with cross arms assembled had an average weight of 4,000 pounds each. This was an unusually good day's work, but the same crew averaged throughout the line 45 poles erected per day, or about 12 minutes to each pole, a large part of which time was consumed in attaching and moving rigging from pole to pole. The pay roll for this crew, including foreman and team, was $180.00 per week, making the cost of erecting each pole about 65 cents.

The wishbone cross arms used are of ¼ x 3 x 3 inches galvanized angle iron, and each arm is composed of two pieces of angle iron bolted together at one end forming a large V, one leg of which passes in front of the pole and the other behind it. This type is shown in the illustration of Fig. 4. The top part of the arm is held in place by a ¾ inch through bolt which also holds the bottom end of the ground wire bayonet on the opposite side of the pole. The bottom part of the arm is clamped to the pole by a ¾ inch U bolt. The two angles are held together by two small bolts which in turn hold the hook on which the insulators are to be hung. These wishbone arms are completely assembled and fastened to the pole together with the ground wire bayonet extension before the poles were raised.

There are a vast number of different styles and sizes of cross arms used throughout the country, and there seems to be no generally accepted standard for transmission lines. The arms in use today are of various materials, dimensions, shapes and spacing. The reason for this is readily understood after a glance at the numerous conditions which must necessarily influence their design, such as voltage for which

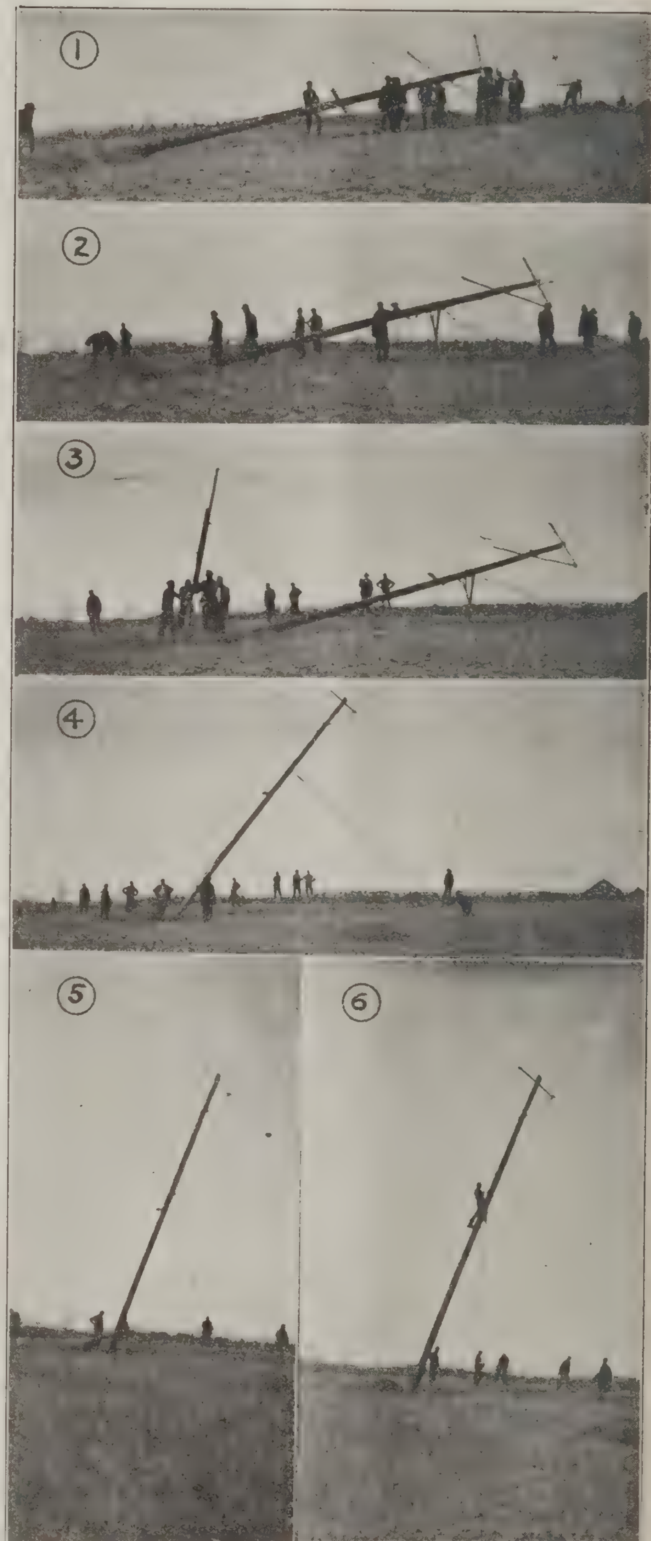


Fig. 4. Stages in the Setting of Poles by a Rapid and Economical Method.

number and weight of conductors to be attached, and length of span desired. The engineer in selecting his cross arms usually looks over the supply offered by various manufacturers, and finding none to fill his specifications, designs a cross arm to suit his conditions. Generally, however, a regular electric light arm of the pin size required to give they are intended, and the spacing required by this voltage, adequate conductor spacing is used, and standard arms of 3¼ by 4¼ inch section are heavy enough for small conductors and average spans. Long leaf yellow pine and Washington fir are the most popular of all timbers for high-class construction, being of good strength and moderate weight, and possesing reasonable lasting qualities, usually from 8 to 12 years.

Until recently no attempt has been made to protect cross arms against deterioration, but with the attention given to increasing the life of the poles, the preservation of cross arms against decay has received attention, and they are now frequently subjected to creasote treatments by the same process as the poles. There are some localities where climatic conditions do not warrant the extra expense of using treated arms. Usually, however, the preservation of cross arms is an economical proposition, and creosoted or Kyanized arms are being used with satisfactory results. The cost of creosoting runs from two cents to three cents per board foot. The Government in one of its Forest Service Bulletins recommends an absorption of about six pounds of oil per cubic foot for Class "A" timber, ten pounds per cubic foot for Class "B," and eight pounds per cubic foot for class "C," intermediate between A and B class timber. As with poles, cross arms should be in a perfectly air dry condition before being treated. Cross arm timber should always be first class, sound, live, straight grained and free from knots and seams.

The writer has used as a standard a creosoted cross arm of long leaf yellow pine with a cross section of 4 x 6 inch and 8 feet long, giving a conductor spacing of 30 inches. This arm is thoroughly capable of supporting a reasonably heavy conductor, and by using a good stout pin, very substantial construction is obtained, which shows up well with big poles, such as shown in Fig. 5. Cross arms should be fitted tightly into a square cut gain and bolted to the pole with a single galvanized through bolt of from ⅝ inch to ¾ inch in diameter, washers being used under the head and nut. Through bolts for attaching cross arms should be ordered with 3 inches of threading to allow for variations in diameters of poles. On corners, curves, extra length spans, railroad or foreign line crossings, double arms should be used, that is, a cross arm on each side of the pole. This gives added strength at these points. Cross arm braces are usually of flat bar or light angle iron, the former being most frequently used in transmission work, one to each side of the arm, attached with carriage bolts through the arm, and fastened to the pole with a ½ inch lag bolt 4 or 5 inches long. The size and weight of these braces should correspond with the size of cross arm used, and in all cases be galvanized, as also should the through bolts, lags, washers and all other pole hardware.

FIG. 5. A SUBSTANTIAL WOOD POLE AND WOOD CROSS-ARM CONSTRUCTION.

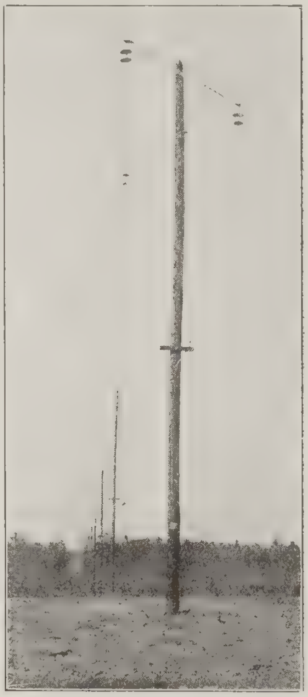


FIG. 6. A WOOD POLE LINE USING STEEL CROSS ARMS.

Specifications for material should provide for all iron or steel, pole hardware, guy wire, clamps, etc., to be galvanized. There are certain sections of the middle West where the climate is very dry and it is a question if galvanizing is of very material advantage, particularly on threads of cross arm and pole bolts, but most conservative engineers recommend galvanized throughout.

The next section of this article will take up pole guying.

The central station company of St. Louis, has abolished deposits formerly required of new residence customers when applying for service. Deposits already made by some 30,000 customers have been returned. In the same way that a smooth road permits a vehicle to carry a heavier load at the same speed on a rough road the removing of obstructions to new business increases the efficiency of solicitation.

The Operation of Rotary Converters

BY WILLIAM R. BOWKER.

Converters may be divided into two distinct classes. (a.) Machines for converting from alternating to direct current. (b.) Machines for converting from direct to alternating, which are known as inverted rotaries. Although converters of the first type are more often met with in the present-day practice, the same machine may be operated either way, as desired, and the distribution of the currents in the windings under both conditions may be considered as follows:

When a converter is transforming from alternating to direct current, it would be running as a synchronous motor and loaded as a direct-current generator. Now the direction of flow of the current in the armature coils of either a D. C. or A. C. machine is in the reverse direction when the machine is running as a motor to what it would when generating. It follows therefore, that the current flowing in the coil of a converter armature at any instant will be equal to the difference between the current flowing when the machine is running as a loaded synchronous motor and the current flowing when the machine is driven as a loaded D. C. generator, assuming the input and output currents are of the same value in each case. As these currents oppose each other, the resultant current in a converter armature is very small, consequently, the armature reaction and heating effect of the currents in a rotary are much smaller than they would be in the case of separate machines of the same output.

In the case of an inverted rotary, when such a machine is running with no load on the A. C. side, its performance is simply that of a direct current motor. A load on the A. C. side, however, will have a similar effect as in the case of a converter of the first type, inasmuch as the resultant armature current flowing at any instant will bear the same relation to the D. C. input and A. C. output.

The power rating of both types of converter depends upon the heating effect of the armature currents, which is not a uniform quantity, as it varies according to the position of a coil in relation to its connection to the slip-rings, the greatest quantity of heat being generated in those conductors nearest the slip-ring connections.

The converter output depends upon the temperature rise and increases with the number of slip-rings. The relative power ratings for a given temperature rise of any particular machine when running under different conditions, as regards the phase of the current generated, are as follows:

Direct current = 100
Single phase = 85.2
Three-phase = 133
Four-phase = 162.5
Six-phase = 193

Note: This article is a continuation of the one in the February issue.

As there is such a wide variation in output under the different conditions, although the temperature rise does not change, it follows that there must be a variation in the resultant current in the armature winding. The ratings as given are based on unity power-factor, but for power factors less than unity the ratings would be reduced. Also, a decrease in power factor would increase the heating when the converter output is held constant.

The resultant, or equivalent currents in the armature winding of a particular machine for different-phase conversion, as calculated from the above figures, would be as follows:

Single-phase = 1/.852 = 1.175
Three-phase = 1/1.33 = 0.75
Four-phase = 1/1.625 = 0.62
Six-phase = 1/1.93 = 0.515

These quantities represent the factors which must be considered when calculating the current squared times resistance (I^2R) loss in an armature of the various types of converter herein mentioned.

A converter may be either shunt or compound wound, the former type being generally used for lighting circuits and the latter for street railway and railway power purposes. With the shunt type a constant wattless current is obtained at all loads, by the adjustment of the exciting current, but it does not admit of phase control. The power factor is the same for all loads, but changes with variable loads, if there is any variation in the reactance of the supply circuit. As the I^2R losses cause the pressure on the D. C. side to decrease with the load, it is necessary to employ compound wound converters for widely varying loads. In the case of a compound wound converter field magnet, the D. C. voltage may be maintained fairly constant, or made to increase with increase of load, in the same manner as with an over-compounded direct current machine, the compound winding being so proportioned that at no load, the machine is under excited.

Under these conditions, the converter Emf. is less than the impressed voltage, and the current in the line is lagging, which increases the Emf. of self-induction, thereby cutting down the voltage of the system. The excitation increases with the load, the counter Emf. being also increased, thus bringing the impressed voltage and current into phase, which results in an increase in the voltage at the primary receiving end, and also on the D. C. delivery secondary side of the converter. As the counter Emf. at full load exceeds the applied voltage, the current will be leading, and the voltage will have its maximum value. It is therefore obvious that a leading current increases and a lagging

WORKING VALUES OF CURRENT IN ROTARY ARMATURES.

System	Number of Slip-Rings.	Angle between Slip-Ring Connections.	Armature Current. Virtual	Armature Current. Maximum	Line Current Virtual	Line Current Max.	Voltage Ratio	Voltage
Single-Phase	2	180°	70.7	100	141.4	200	$1 \div \sqrt{2}$	70.7
Two-Phase (4 wires)	4	90°	50	70.7	70.7	100	$1 \div \sqrt{2}$	70.7
Three-Phase	3	120°	54.5	77	94.3	133.3	$(.5 \times \sqrt{3}) \div \sqrt{2}$	61.2
Six Phase	6	60°	47.2	66.7	47.2	66.7	$(.5 \times \sqrt{3}) \div \sqrt{2}$	61.2

current diminishes the voltage at the terminals of a rotary converter.

If a compound wound converter is excited so as to give unity power-factor at full load, its value will be decreased on light loads. As already pointed out, the current for compounding, in the case of a converter, must lag on light, and be leading the voltage on heavy loads, which therefore necessitates that there be a certain amount of reactance on the A. C. side of the rotary.

One of the most complicated problems connected with the operation of converters is that of obtaining satisfactory pressure regulation, which is due to the fact that the ratio of D. C. voltage to that across any two slip rings is practically constant for any particular machine, and is quite independent of the field excitation. Therefore any alteration in the D. C. voltage can only be effected by a corresponding change in the voltage on the A. C. side, such variation being either adjusted by hand regulation or automatically by compounding the rotary.

In the case of hand regulation, this is effected by means of an induction regulator or a transformer, the ratio of which may be altered between wide limits. Automatic excitation is effected by causing the converter to take a leading or a lagging current by varying its excitation, and consequently its counter electro-motive-force.

When running on light loads the machine may be caused to take a lagging current by adjusting the shunt field, and inserting reactance coils in the A. C. circuits. As the load increases, the compound field winding increases the excitation, which decreases the angle of lag, thus increasing the voltage across the slip-rings, and consequently the pressure on the D. C. side.

When the load reaches its full value, the current on the alternating side of the rotating armature will be leading, and the direct current volts will have increased in proportion to the increase in the slip ring voltage.

Although converters possess similar characteristics to those of the synchronous motor and the direct current generator, these facts do not tend to simplify the complications met with in practical operation.

As the pressure between the slip rings is usually about 61 per cent of that on the D. C. side, it is always necessary to insert step-down transformers between the slip rings and the alternating current primary supply circuit. It is the general rule to transform the incoming primary transmission circuit voltage down to about 330 volts by means of three separate transformers, which are delta or mesh connected on both their incoming primary and outgoing secondary or high and low pressure sides.

As regards the hand regulation of converters, this may be effected in several ways. (1) By inserting a choking coil in each phase, which has the disadvantage of lowering the power factor of the supply system. (2) Varying the ratio of transformation of the transformers on the A. C. side of the converter by means of a special switch, which increases the expense as it necessitates special windings on the transformers.

Another method is due to a German company and consists of a small alternator which is mounted on the converter shaft, its windings being connected in series with those of the converter. The small alternator acts as a booster, and may be made to add or subtract volts to or from the primary supply circuit by adjusting and reversing its excitation. This method is also expensive, and is not suitable when heavy currents have to be dealt with. The most satisfactory method and that most commonly used, employs an induction regulator in each phase. This apparatus consists of a stationary iron core which is connected in series with one-phase. Inside this is a movable core carrying a primary winding, which is connected in series with the supply circuit. This core is capable of turning through 180 degrees, the secondary voltage being at its maximum when it is in a vertical position, gradually diminishing as the core is turned round and finally becoming zero when the core is in a horizontal position. When the core is in this latter position, the magnetic fields due to the two windings neutralize each other.

With a three-phase converter, an induction regulator is required in each phase, the handles of each being interlocked so that the voltage may be equally adjusted in each phase simultaneously. These regulators are always connected in the secondary low pressure circuits of the step-down transformers, and are very effective and inexpensive, giving a range of 5 per cent both ways, and are not liable to get out of order or defective, owing to the absence of contacts.

Perhaps a more efficient form of regulator is that due to Mr. M. B. Field. In this case the secondary of each transformer carries a few extra turns, which are connected through a small regulating switch to the windings of a small auxiliary transformer, the secondary winding of which is in series with the low-tension circuit, adding to or subtracting volts from this circuit as desired.

With further reference to the automatic regulation of compound field wound converters, it may be mentioned that the excitation controls the phase relation existing between the A. C. current and A. C. terminal voltage. As already stated, the excitation necessary for a power factor of unity varies with the load, the current then being in phase with the voltage.

Should the excitation be too small to give unity power factor at that particular load, the supply current will lag behind the voltage. On the other hand, if the exciting current is too great, the current will lead the voltage in phase, and the power factor will still be less than unity. The effect of this is to cause the voltage across any self-induction placed in the circuit to vary in phase with the applied voltage, which in turn varies with that across the slip rings.

A comparison of the methods mentioned above, for regulating the pressure on the D. C. side of a converter, shows that in the case of a shunt-machine connected to a lightning circuit, it is possible to obtain very satisfactory regulation by means of induction regulators adjusted by hand, in accordance with the variations of load. For widely varying loads, such as are met with in railway practice, the use of a compound-wound field type of converter, in which regulation is automatically effected by means of lagging and leading currents, is more suitable for this class of service.

The next section of this article will take up the starting of rotary converters.

Ambition is just this and nothing more—to dream big dreams and work like thunder to make them come true.

A business man frequently does his best work when he seems to be doing nothing at all. This is the time when he originates and plans bigger things for his business.

The Illumination of the Show Window

BY JOHN A. HOEVELER, ILLUMINATING ENGINEER.

IT has been said that the retailer—the man with a store—has no better salesman at his command than his show window. It can display goods and emphasize values in a most alluring manner and is ever on the job. If this is true of a window in the day time, when everyone is passing along the streets hurriedly, how much more valuable is that same window at night, when the multitude moves along more leisurely? We may even go further and say that the most "attention compelling" windows, are the brightest windows—the ones that stand out in contrast to their dimmer surroundings. This emphasizes the need of illuminating a window, and illuminating it brightly.

With the advent of the incandescent electric lamp, show window illumination advanced tremendously, at least insofar as brilliancy was concerned. The popular method of illuminating the window was to outline it with bare lamps. The result was a "much lighted" but hardly a "well lighted" window, since it is a matter of common knowledge how difficult it is to see past such a wall of light. The next step was the use of ornamental lighting fixtures centrally located in the window, and this is still the popular method with many small merchants. From the illuminating standpoint it is not particularly good. Deep shadows are cast on the front of the goods, which are close to the plate glass. The glare from the exposed lighting units interferes with clear, comfortable vision. The progressive merchant has therefore discarded the ornamental lighting fixture for window lighting purposes for another reason, which is purely commercial. He is in business to sell his own particular line of goods, not lighting fixtures, and therefore it is folly for him to place his own goods at a distinct disadvantage by crowding his window with highly ornate lighting fixtures. Fig. 1 shows a poorly lighted window. The lighting equipment consists of a long brass rod, supported from two chains, from which the lights are suspended at frequent intervals.

The present day conception of a well lighted window, is the window in which the goods displayed stand out attractively, secures the interest and holds the attention of the observer, without causing a thought to arise in his mind relative to the means by which the lighting is accomplished. Perhaps it was the commercial aspect, and the prime necessity for attractively and effectively illuminating the show window that first taught us the advantage of concealing the light sources. Certainly we have learned it most thoroughly, and have practised it most consistently in connection with window lighting.

CLASSIFICATION AND REQUIREMENTS OF SHOW WINDOW LIGHTING.

In general, show windows may be divided into two classes: open-back and boxed-in. Open-back windows are typical of the small country store—grocery, meat market, etc.,—on the outskirts of a city, and in many small towns. Boxed-in windows, on the contrary, are more common with the higher class stores. Included in this class are all windows which have a solid and opaque background part or all the way to the ceiling. Usually these windows are provided with a false ceiling, and in some cases are arranged in two tiers.

In citing the requirements for window lighting, the open-back window will be left out of consideration, since the lighting of these windows usually is only a continuation of the store lighting. In many instances they have no special lighting, and in practically all cases, where they have special lighting equipment, the illumination of the front of the store also is derived from them.

In order that the boxed-in window may be effectively and pleasingly illuminated the following requirements must be fulfilled: (1) The lamps must be concealed. (2) The light must be properly directed. (3) The intensity must be ample. (4) The illumination must be uniform. (5) The color of the light must be pleasing. The importance of directing the light from concealed sources has already been mentioned. A person can easily prove this to his own satisfaction by observing the lighting of the windows along a live business street. The windows that attract attention and stand out from their neighbors, invariably are the ones in which this principle is carried out.

The direction of the light is of equal importance to the above consideration. Windows are trimmed in accordance with well defined principles: the low and flat display at the front, and the high vertical display at the rear. Hence the "line of trim" takes a pretty well defined form as indicated in Figs. 2, 3, 4. The horizontal display at the front requires a high horizontal component of illumination, whereas the vertical display at the rear requires a high vertical component. The simplest manner of securing these results is the use of a properly designed lighting unit placed at the front and top of the window.

The intensity of illumination required on the line of trim depends on numerous conditions: the intensity of the street illumination, the brightness of neighboring windows, the class of goods displayed and the color of the goods and background. In order that a window may attract attention it must be illuminated much more brightly than the street. It will then stand out by contrast. If the window is located on a street, of which the general standard of window light-

Fig. 1. Incorrect Window Lighting, Showing Results of Glare from Exposed Units and Shadows from Incorrect Position of Units.

ing is high, the minimum effective intensity would be that of the neighboring windows. Some classes of goods require extremely high intensity of illumination, others require only moderate intensities. As an example—men's furnishings as a rule require only a moderate intensity. Clothing on the contrary requires a high intensity. In general, dark goods require much higher intensities than light goods. A light background will always give a window a bright appearance even with comparatively low intensities, whereas the dark background tends to produce the opposite effect. Mirrored backgrounds should not be used. One of the chief reasons why merchants desire mirrors, is the fact that they believe the observer will be enabled to see both the front and

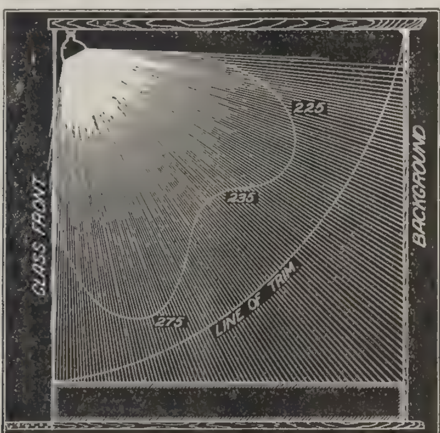


FIG. 2. CROSS-SECTION OF WELL LIGHTED WINDOW WHERE HEIGHT EQUALS DEPTH AND WITH HIGH TRIM.

back of the objects in the window. However, the brightness to which the back of the objects is illuminated is so low that the results are not very satisfactory. In addition to this, much brighter images of surrounding objects detract rather than add to the effect sought.

The need of uniform illumination in the show window hardly requires any special comment; it is apparent on the face of it. A uniform spacing of lighting units of proper design, along the front of the window, will accomplish this. The color of the light of the tungsten lamp is most satisfactory for window lighting, and the tungsten lamp has

FIG. 3. CROSS-SECTION OF WELL LIGHTED WINDOW WHERE HEIGHT EQUALS 1½ TIMES DEPTH WITH MEDIUM HIGH TRIM.

largely displaced the carbon lamp. The new gas filled tungsten lamps produce a light which is nearer daylight in color than the vacuum lamps. However, this lamp as yet is made only in large sizes, which are not well adapted to window lighting, because only one or two lamps would be used where now a dozen or more small lamps are employed. It is needless to say that this would not give satis-

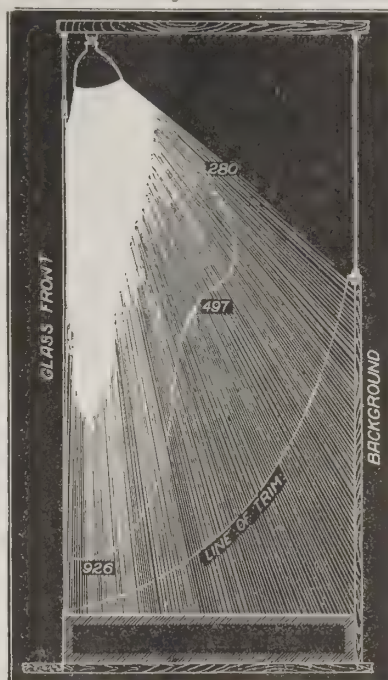


FIG. 4. CROSS-SECTION OF WELL LIGHTED WINDOW WHERE HEIGHT EQUALS 2 TIMES DEPTH WITH MEDIUM HIGH TRIM.

factory results because of the poor diffusion and consequent deep shadows. However, from present indications it may not be long before this type of lamp will be available in small sizes, suitable for window lighting.

The problem encountered when designing lighting equipment for show window illumination is of a very special nature. The angle intercepted by the line of trim in the plane perpendicular to the glass varies from 50 to 95 degrees, depending upon the dimensions of the window. This imposes the first condition to be solved. The light flux of the lamp must be confined to an angle of 95 degrees. Figs. 2, 3 and 4 are cross sections of three typical windows. The line of trim of the window of Fig. 2, subtends an angle of 95 degrees; in Fig. 3 it subtends an angle of 65 degrees; and in Fig. 4 it subtends an angle of 50 degrees. For each of these windows a different distribution of light is required, as shown.

FIG. 5. TYPE OF SILVERED GLASS WINDOW REFLECTOR.

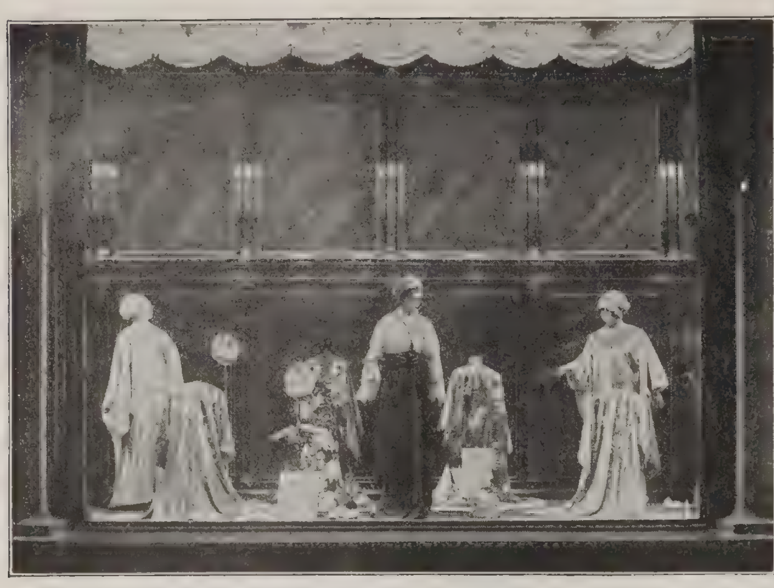


FIG. 6. CORRECT WINDOW LIGHTING FROM CONCEALED SOURCES. EQUIPMENT—100 WATT TUNGSTEN LAMPS WITH X-RAY REFLECTORS SPACED ON 18-INCH CENTERS.

A study of the characteristics of reflecting surfaces will at once indicate that only surfaces following the laws of specular or of spread reflection are capable of giving the necessary concentration of light and of these, the specular surfaces are preferable, inasmuch as they permit variation in the light distribution in accordance with the wishes of the designing engineer. A reflecting surface following the law of diffuse reflection would be incapable of giving the required concentration, and any reflector of this type, designed with this purpose in mind, would be inefficient indeed, due to excessive losses by internal reflections.

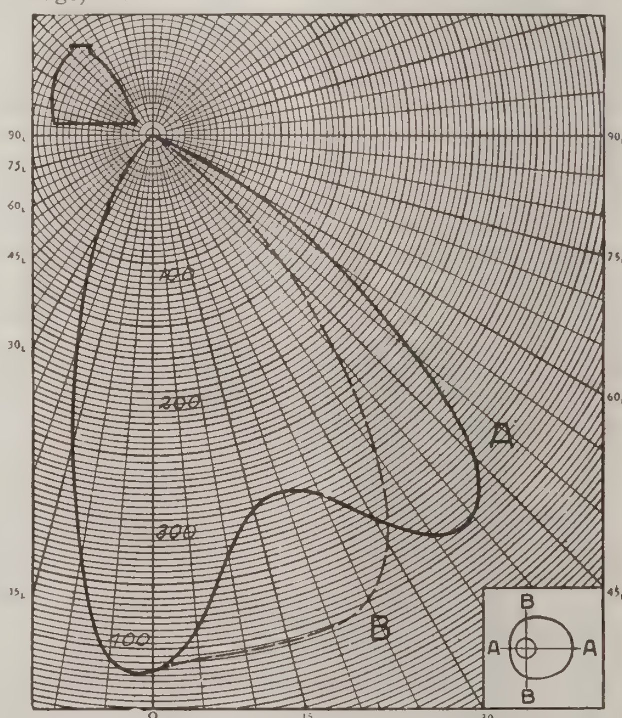
The pioneer equipment for concealed lighting of show windows is the familiar trough, constructed of metal and lined with white opal glass, or strips of ripple mirrored glass in which the lamps are placed vertically or horizontally at frequent intervals. While the trough reflector marked a great advance in window lighting methods, and dominated the field for a long time, it has numerous defects. There is a great waste of light due to the lack of control of the end-wise light flux, the interference of light flux of adjacent lamps, and the lack of sufficient variation in design to meet the variable conditions encountered in practice. The distribution of light from the trough is not uniform over the trim. The bulk of the light flux is confined to the upper portion of the window, with consequent insufficiency at the front and bottom. However, the trough is far ahead of the old systems of exposed lighting.

Any individual reflector for each lamp prevents much of the waste of light characteristic of the trough, and makes possible a more even distribution over the line of trim. Such reflectors preferably should be non-symmetrical, with a distribution of light that cuts off sharply at the edge of the window and at the top of the trim. Symmetrical reflectors placed at the front of the window in a vertical position are wasteful—practically half of the light escapes through the plate glass onto the sidewalk—and do not give an even distribution of light on the trim. The concentrating type of symmetrical reflector may be used to advantage when tilted at an angle. By a study of the conditions in any particular case, an arrangement of concentrating symmetrical reflectors tilted at a number of different angles may be secured, which will give goodresults. The installation of such equipment, however, entails constructional difficulties, which are entirely overcome by the use of non-symmetrical reflectors in which the lamps hang pendant.

Specially designed silvered glass reflectors (specular reflecting surface) of the type shown in Fig. 5 are meeting with wide application. They are designed in a variety of sizes and shapes, and cover the field in a most complete manner. Fig. 6 shows a window illuminated by means of 100 watt tungsten lamps equipped with these silvered glass reflectors. The light distribution curve of the reflector used is shown in Fig. 7.

A comparison of Figs. 1 and 6 will bear out what has been said concerning the need of concealing the light source, of proper direction of the light, and of uniformity of illumination on the trim. In Fig. 1 note the glare due to the lighting units, and the consequent loss of detail on the trim adjacent to the units. Note the front of the two forms in the foreground are in deep shadow, because the lighting units are placed centrally, and the light for these objects is from the rear. The non-uniformity of the illumination is apparent. Now note how all these features have been eliminated in the window of Fig. 6.

The illustrations used with this article were furnished through courtesy of National X-ray Reflector Company of Chicago, Ill.



Angle	Candle Power Curve A R	Curve A L	Curve B R	Angle	Candle Power Curve A R	Curve A L	Curve B R
0°	415.0	415.0	415.0	90°			
5°	388.0	411.0	408.0	95°			
15°	301.0	247.0	408 0	105°			
25°	307 0	118.0	400.0	115°			
35°	380.0	22.0	297 0	125°			
40°				135°			
45°	353.0	4.2	137 0	145°			
55°	156.0		24.6	155°			
65°	20.5		3.1	165°			
75°	2.4			175°			
85°				180°			

Reflector X-Ray Visor.
Holder $2\frac{1}{4}$" Form "H".
Lamp Clear Mazda. S-30-A.
Watts 100.0 Volts 110.0
Plotted by [illegible] Test No. DW-7.
National X-Ray Reflector Co.
Engineering Department
CHICAGO
Date Aug. 7, 1913.

FIG. 7. LIGHT DISTRIBUTION FROM AN X-RAY REFLECTOR WITH 100 WATT TUNGSTEN LAMP (1.08 W. P. C.).

Telephone Communication Established Between New York City and San Francisco

Dr. Alexander Graham Bell on January 25, talked from New York City to San Francisco with Thomas A. Watson, an associate in the early development of the telephone. This conversation formally opened telephone service between the Atlantic and Pacific oceans, a distance of 3,400 miles over 3,600 miles of telephone line.

Less than forty years ago Alexander Graham Bell, standing in a litle attic at No. 5 Exeter Place, Boston, sent through a crude telephone, his own invention, the first spoken words ever carried over a wire, and the words were heard and understood by his associate, Thomas A. Watson, who was at the receiver in an adjacent room. On that day, March 10th, 1876, the telephone was born, and the first message went over the only telephone line in the world—a line less than a hundred feet long. The world moves a long way ahead in the span of one man's life. On Monday afternoon, January 25th, this same Alexander Graham Bell, sitting in the offices of the American Telephone & Telegraph Company, at New York, talked to this same Thomas A. Watson in San Francisco, over a wire stretching 3,400 miles across the continent.

Monday, January 25, 1915, has taken its place among the momentous dates in the annals of science and human progress. On that day, in the presence of groups of prominent men on either coast, the Transcontinental telephone wires were given their first public test, and the completion of the line was formally celebrated. Distinguished men in the offices of the Pacific Telephone & Telegraph Company in San Francisco conversed freely with distinguished men on the Atlantic seaboard, and one more great chapter in the history of telephony was finished as Bell, sitting in the offices of the American Telephone & Telegraph Company in New York, talked to Watson across a continent.

Most wonderful of all, perhaps in the minds of those present at the opening of the new line was the fact that this achievement, the crowning glory of so vast and complex a system, had taken place within the space of a man's lifetime. On March 10th, 1876, Professor Bell, working away at the simple telephone he had invented, called to his comrade, "Mr. Watson, come here, I want you," and Watson heard that first of all telephone messages over the wire. In New York, thirty-eight years later, the same voice was talking and in San Francisco the same ear was listening as on that spring day in 1876 but under what different conditions!

The telephone line from New York to San Francisco or really from Boston to San Francisco, since communication between these points is now possible, has come as an evolution from the two-mile line constructed between Boston and Cambridge in 1876. In 1882 the line was extended from Boston to Providence, R. I., 45 miles, and two years later New York, 235 miles away, was connected telephonically with Boston. Then the real westward warch began and in 1893 the line between New York and Chicago, 900 miles, was opened.

Long distance communication rested for a while as far as the public was concerned. Omaha was established as the western outpost less than five years after Chicago was reached. Denver was added to the list in 1911, and in 1913 New York was connected with Salt Lake City.

The route followed by the transcontinental telephone line is shown on the accompanying map. Beginning from the San Francisco end, the first city it touches is Salt Lake City, Utah, 770 miles east. This section was the last to be completed and was built under difficulties. The pole line crosses salt swamps and lakes little more than swamps, where poles were set in water from 18 inches to 3 feet deep. The usual size of poles is 4 inches square at the top, 8 inches square at the bottom and 18 feet in length. They are of redwood and had to be hauled by wagon to the points where used. Owing to the mountainous nature of the country many difficulties were encountered in getting both poles and cross arms to their proper places. There were no roads and the construction gangs had to make their own pathways.

The line is carried from Salt Lake City across the Rocky Mountains to Denver, 580 miles, and then across the plains to Omaha, 585 miles. Crossing the states of Iowa and Illinois, Chicago is reached, 500 miles to the east of Omaha.

ROUTE OF TRANSCONTINENTAL TELEPHONE LINE 3,600 MILES LONG AND OPENED JANUARY 25.

From Chicago eastward the line branches. One branch extends to Pittsburgh, 545 miles, and thence to New York, 390 miles farther. There is a continuation of this branch to Baltimore and Washington. Philadelphia is reached over this branch through a connection at Newtown Square. The other branch passes from Chicago to Buffalo and thence to New York. Boston is on this branch, being reached by way of Buffalo. The accompanying map clearly shows the route followed by the line. In its course across the continent to New York City, thirteen states are entered.

There are three circuits comprising this line—two physical and one phantom. All circuits are loaded with Pupin coils not much more than four or five inches in diameter The coils are made of fine iron wire .004 of an inch in diameter, some 13,600 miles of it being on each physical circuit The two physical circuits are of No. 8 B. W. G. hand drawn copper wire weighing 870 pounds per circuit mile and being .165 of an inch in diameter. Another statistic of interest relative to the pole line is that there are 130,000 poles in it.

Installation, Operation and Maintenance

This section is devoted to practical suggestions, experience and data, and is open to all readers who have something to say on every day work and trouble in the plant or sub-station, on the line, in the factory, mill or elsewhere.

A Hurry-up Installation.

During the latter part of 1914, the Trinidad Electric Transmission Railway and Gas Company, of Trinidad, Colorado, contracted with the St. Louis Rocky Mountain and Pacific Company, just over the border in New Mexico, to furnish power to all of its coal mines. This contract required the construction of some 56 miles of 44,000 volt transmission line and the installation of six out-door type substations. In addition to this new construction, we have in the neighborhood of 100 miles of 22,000 and 6,600 volt lines and transmit power to most of the coal mines in Southern Colorado. The mines of the St. Louis Rocky Mountain and Pacific Company were equipped and ready for our service about the middle of last December, and since that time their mines have been operated by our power with very satisfactory results.

On Saturday morning February 6th, about two o'clock, the substation at the largest mine was totally destroyed by fire, probably of incendiary origin. The substation contained motor generator sets and a rotary converter for direct current which is used in the mines, and this equipment was a total loss. The out-door substation belonging to the power company, although adjacent to their substation building, was only slightly damaged. The mining company's substation not only contained the converters for the power company's 60 cycle current, but also contained rotaries for the 25 cycle current recently furnished from the mining company's own plant at the lower station. The burning of this station shut the mine down completely, as it had no other way of producing power. This mine produces in the neighborhood of 2,000 tons of coal a day, and employs about 450 men, and the shut down would have been serious to the mining company, as it had several contracts depending on the production from this mine, among which was one for furnishing the Santa Fe Railway with coal.

There was no available equipment any place around for this work, and upon learning of the situation, the power company in order to help out in the difficulty, removed from the power plant at Trinidad one of the rotary converters that is used for producing direct current for railway purposes. This equipment, together with its three-phase transformer and switch board apparatus, was installed in a large furniture car furnished by the Santa Fe Railroad. The order was given to start to move this machine at 11:30 Saturday morning, and as the power house is not equipped with a crane, it was necessary to handle the transformer and rotary by hand. It was taken around rather devious courses, loaded on to a flat car, pulled out to where the box car was standing and then loaded into the car. As soon as it was installed in the box car the men began wiring it up in the car, and a special engine from the Santa Fe took it over Raton pass and to the Keohler mine, about 60 miles from the power house. The men connected up the machin-

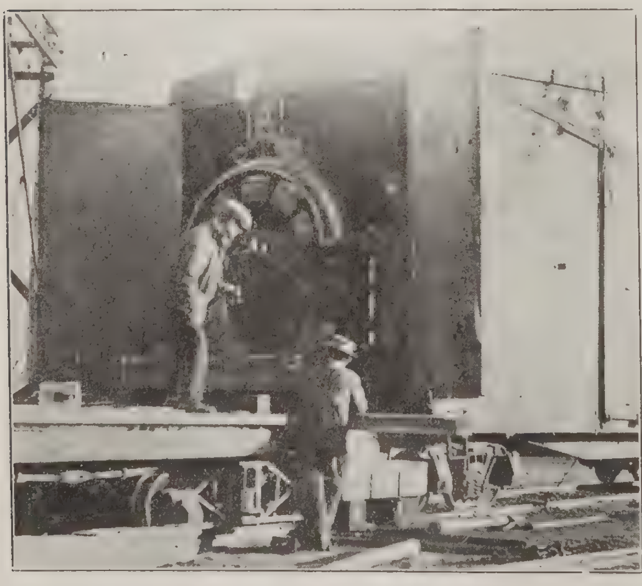


Fig. 1. Loading Rotary Converter for Shipment and Emergency Use at Coal Mine.

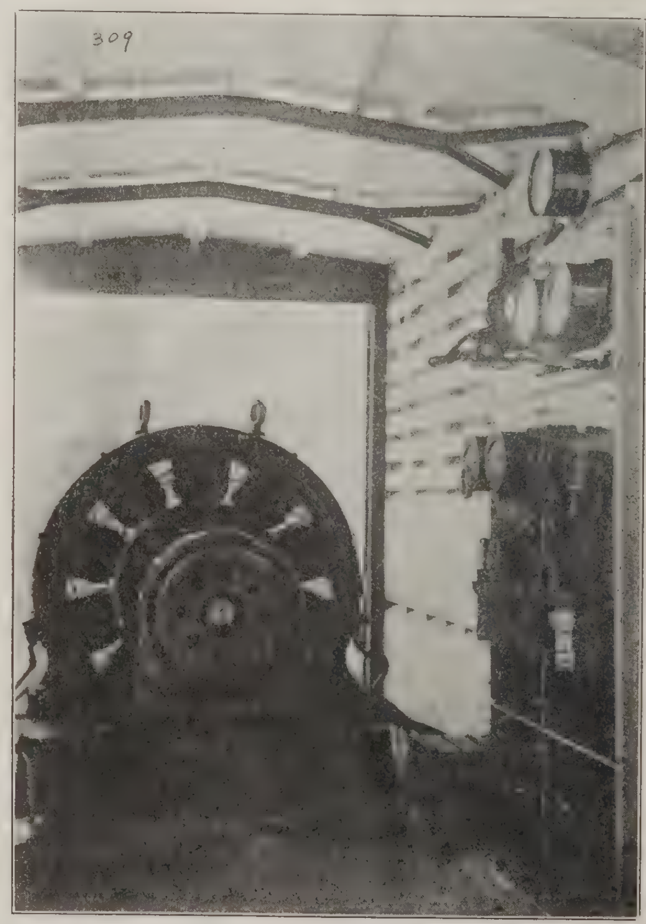


Fig. 2. Arrangement of Converter and Switch Board in Box Car.

FIG. 3. CONVERTER LOADED, WIRED AND IN OPERATION 44 HOURS AFTER EMERGENCY CALL FOR IT 60 MILES AWAY.

ery during the trip over the pass and at 7:30 Monday morning the machine was running and supplying current for the operation of the mine. The mine was shut down only one regular working day. Our work was greatly appreciated by the mining company, as it did not see at first how to get out of the trouble with less than a three or four weeks shut down.

The accompanying illustrations show the loading of the rotary converter at Trinidad for shipment to the coal mine and the connections for emergency operation at the mine.

Franklin P. Wood,
Manager, Trinidad Electric Transmission Railway and Gas Co.

The Cost of a Kilowatt Hour.

Even the operators of generating plants who are familiar with the details of plant operation and experts in their line of work, do not fully realize the ways in which they can help to produce a kilowatt hour at the smallest cost. In what follows a simple explanation is given of the different items entering into power plant costs in such a way that every operator can at once see how his honest effort and best thoughts will help in reducing operating costs. These remarks are abstracted from an article by Mr. Casey in the Tramway Bulletin.

The cost of power may be divided into two separate items—first, fixed charges, and second, operating costs—each of which has its own particular relation to the cost of a kilowatt hour. A power plant represents a certain sum of money invested in buildings, property and equipment, so that the term of fixed charges becomes effective as soon as these are purchased.

FIXED CHARGES.

In order to purchase buildings, property, etc., money must be obtained from some source, and this money cannot be exchanged for fixtures without incurring a loss equal to its earning power, which is its interest. If the rate of interest on borrowed money be 6 per cent, then 6 per cent of the total cost of the power plant goes as a part of fixed charges.

The next important item under fixed charges is depreciation. The life of power plant machinery may be estimated from fifteen to twenty years, although the latter is somewhat long when efficiency is taken into consideration. Interest must be paid yearly on the cost of equipment. Now, to show how depreciation enters into fixed charges, let us imagine what would be the condition of things when the present equipment becomes no longer serviceable and impossible to operate with any degree of economy. Either another loan must be secured, thereby doubling the interest on the investment, or enough money must be on hand to purchase new equipment. The method of accumulating this money is based on the estimated life of the machinery. For example, if the estimated life were taken at fifteen years, then one-fifteenth of the initial cost is laid aside annually so that at the end of fifteen years enough money is on hand to replace the present equipment. The per cent of depreciation varies under existing conditions and may be anywhere from 5 to 15 per cent, depending upon the nature of the apparatus under consideration.

AMORTIZATION.

Another term similar to depreciation is obsolescence, which provides for the purchase of new and more efficient equipment before the estimated life of the installed apparatus has expired. The two terms, depreciation and obsolescence, are sometimes taken together and called the amortization fund, which is so proportioned that a certain per cent, if set aside annually and allowed to accumulate at compound interest, will always be of sufficient amount to make any changes or replacement that may be demanded in the ordinary occurrence of events. The remaining items under fixed charges, which are insurance and taxes, need no explanation.

Summing up fixed charges, we have interest, depreciation, obsolescence, insurance and taxes, which, taken as a lump sum, remain the same whether the plant is running at its full capacity for 24 hours a day or remaining idle at all times.

OUTPUT REGULATES COST.

From the above it may be seen that the greater the Kw. hr. output the lower the cost per Kw. hr. This is shown by the term load factor, which has several meanings when used pertaining to the output of power plants, so that it is best to state what particular meaning is intended. "Load factor" is the ratio of the average demand to the maximum demand and is based on a 24-hour day.

To show how load factor affects fixed charges per kilowatt hour, we shall take for illustration a gas plant as compared with an electric plant. If a customer consumes 240 cubic feet of gas per day, the cost of production is just the same if the entire 240 cubic feet are used in one hour and none at all in the remaining 23 hours, or if it be used at a uniform rate of 10 cubic feet per hour for the full 24 hours.

Since gas is produced at whatever rate is the most economical and stored in gas tanks, it may be supplied from there at whatever rate it is demanded. What an ideal installation this would be if we could only store electricity with the same per cent of economy as to the first cost and operating costs.

The most serious disadvantage of electrical energy is that it cannot be stored. We all know that there exists the storage battery, and that it is used to a large extent where absolutely reliable service is required, but in this we do not in reality store electricity directly, but store it by converting it into chemical energy, and then by discharging

the battery, reconvert into electrical energy. Since the first cost of a storage battery is quite high and the life short, it is rather an expensive piece of equipment.

THE LOAD FACTOR.

Now let us consider the electric plant with a daily output of 240 Kw. hr. and see how it affects the investment. If we use this energy at the rate of 10 kilowatts per hour, our investment will be on a 10 Kw. equipment and our load factor in this case would be 100 per cent. Consequently our fixed charges per Kw. hr. would be low. But if we used 240 Kw. in one hour and none in the remaining 23 hours, our investment would be on a 240 Kw. equipment. As the maximum demand is for 240 Kw. for one hour, and the average demand is 10 Kw. per hour, this would bring the load factor extremely low. Consequently the fixed charges per Kw. hr. would in the latter instance be approximately 24 times as great as the former.

OPERATING COSTS.

We shall now mention the second principal item that affects the cost per Kw. hr., which is the operating costs. Operating costs are made up of the following items given in the order of their relative importance: Fuel, labor, maintenance, oil, waste and supplies.

Fuel (coal being considered, owing to its almost universal use) is generally considered the largest factor in operating costs, and also the most fluctuating, for the reason that the fuel consumption varies according to the output of the station. The amount of coal used per Kw. hr. depends upon two things, viz.: The amount of steam generated per pound of coal fired and the amount of steam consumed per Kw. hr. by various power plant machines. Each of these items depend upon other variables. The steam produced per pound of coal depends upon the heat values of the coal, the manner in which it is fired, the temperature of the feed water, the general boiler conditions, and the load. The steam consumed by the prime movers per unit of delivered power depends upon the efficiency of the machinery, the method of drive between engine and generator, and the vacuum. The steam generated per pound of coal is termed "evaporation" and the results of many evaporation tests show figures varying anywhere from less than three pounds to over 10 pounds of water per pound of coal. The steam consumption of pumps, engines, compressors, etc., depend wholly upon their individual design, engine and engine type pumps varying from 20 pounds per indicated horsepower for high-grade machinery to around 75 pounds for ordinary simple type.

Next to fuel, labor is the highest expense in operating costs. Inasmuch as it is a constant expense, it affects the cost per Kw. hr. in the same manner as fixed charges.

Oil, waste and supplies are rather indeterminate quantities and will probably fluctuate from time to time.

In the preceding remarks I have not attempted to explain in detail any of the items but have merely endeavored to show in a non-technical way the number of different things that must be considered in the production of power. Therefore, let all who are operating apparatus where power is consumed make every effort to use it as economically as possible, as a saving of 1 per cent in power is quite an item to any company.

William E. Casey,
Chief Electrician Denver Tramway Company,
Denver, Colo.

Additional Information on the Functions of Lightning Rods With Installation Features.

Some of the data given in the November, 1914 issue of Electrical Engineering on functions of lightning rods, does not altogether agree with the accepted practices relating to the installation of lightning rod equipment, and in view of this the writer submits the following additional information.

In Mr. Howard R. Smith's contribution it is stated that "the rod should be well insulated from the building." This is doubtless a misprint inasmuch as it is now universally agreed that the safer practice is to so arrange the rodding that it will be in fair electrical contact with the building. One accepted method of securing the rod is shown in Fig. 1, where it is secured against the surface of the building with a cleat of the same metal as the rod itself. If the rod is of iron, the clip should be of iron, or if the rod is of copper, the clip should be of copper and should be held to the building surface with copper nails. Dissimilar metals should be avoided—to prevent electrolytic action.

In some localities it is the practice to support the rodding away from the surface of the building with a metal clip or so-called dispenser as shown in Fig. 2, because the advocates of the method hold that where the rod is secured directly on the surface of the building as in Fig. 1, there is a possibility for the accumulation of lint and combustible dust under it that might cause a fire if the rod becomes overheated. This possibility is eliminated with the construction of Fig. 2. However, the most popular practice is that shown in Fig. 1 and it is very likely the best one, as it is more secure and the possible dangers from fire that it is said to induce, have not apparently materialized in practice.

Note that in both Figs. 1 and 2, the rod is in fair electrical contact with the surface of the building. There are two good reasons why the rod should be in contact with the building. The first is that it really does no good to try to insulate it. If one considers that the average potential gradient of a lightning discharge is something like 50,000 volts per foot, giving the voltage of a two mile flash as something like 50,000,000 volts, the impossibility of insulating a current at this pressure with the small glass

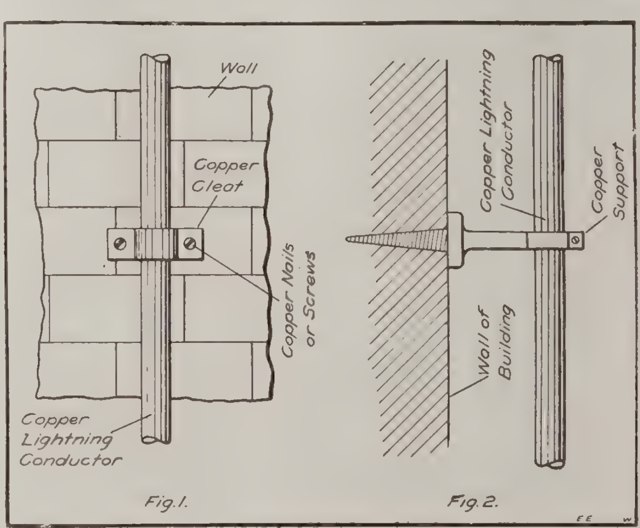


Fig. 1. Lightning Conductors Attached to Building Wall With Cleats. Fig. 2. Copper Support Holding Lightning Conductor Out From Wall.

insulators such as are ordinarily used with lightning rods, is apparent. After a lightning discharge has broken down a couple of miles of air in its path to earth, it is obvious that a glass or porcelain insulator a couple of inches in diameter can have little influence on its action one way or the other. Therefore, from the standpoint of controlling the path of the lightning discharge current, the insulators on which lightning rods are sometimes supported are useless.

Secondly, it will be shown that the insulators are not only useless, but really harmful. In connection with Fig. 2 of the writer's letter in your November issue it was shown that the points of lightning rods tend to discharge electricity and thereby prevent lightning strokes. If these points are to discharge electricity most effectively, provision should be made that will facilitate the rapid flow of the electricity on a building and in the ground surrounding it, into the lightning rod conductors. If the conductors are insulated from the building the electricity, induced on the building by the charged cloud above it, encounters considerable opposition and cannot therefore flow rapidly from the surface of the building into the lightning conductors. If the rod is very well insulated and the air is very dry, it is possible that the electricity which is drawn up on the building by the attractive action of the charged cloud above it, cannot flow into the lightning rod at all. It is therefore apparent that the insulation of lightning conductors from a building tends to defeat one of the most important functions of the rod, namely, that of discharging electricity.

In regard to grounding, experience has shown that if each lightning conductor is led down into the soil at least 10 feet, so that it will reach permanently moist soil that effective protection will be provided. Patent grounding devices and ground plates are apparently unnecessary. Auxiliary connections should be made to water pipes where such pipes are available.

Experience has shown that a copper conductor of any section—square, flat or round—weighing at least 3 ounces per foot, will give adequate protection for ordinary residence or farm house installations, and will not be fused under ordinary circumstances by a lightning discharge current. Where iron is used for a rod, it should be of such section that it will weigh at least 4½ ounces per foot.

From an electrical standpoint, it can be shown that iron is as good and possibly better for conveying the extremely high frequency current (something like 500,000 cycles per sec.) of a lightning discharge current, but iron, even if it is well galvanized or painted will ultimately rust out and for that reason copper is now usually considered preferable and is in some cases the only approved material. A system of properly designed lightning rods of iron will give as good protection as one of copper as long as the iron system remains intact.

It is stated that a building well surrounded by tall trees is immune from lightning flashes. This may be true in certain cases, but as a general proposition it is doubtful whether it would be safe to rely on the protection that may be afforded by trees. The paths of lightning discharge currents may be shifted one way or the other by the wind and there are other factors that render it impossible to pre-determine the probable path of a lightning stroke. Experience has shown that the only safe way to protect a building is to locate points or air terminals over its entire surface at intervals from 20 to 30 feet. Where a building has a gable roof, such as shown in Fig. 3, that is, where one portion is much higher than the rest, a fairly adequate protection is frequently provided by spacing the air terminals at 20 or 30 foot intervals only along the ridges or highest portions of the building. Each chimney, steeple, or cupola that extends above the balance of the building should have a point of its own, as is shown in Fig. 4. There should be one ground connection for every five air terminals or points.

As is stated in Mr. Smith's letter, buildings of reinforced concrete are very well protected by the steel reinforcement imbedded in the concrete but terminals extending out above the building should be connected to this steel reinforcing system to receive the possible lightning discharge stroke. If this precaution is not taken a lightning discharge may break, and has in certain cases, broken away the concrete in making its path to the steel reinforcement.

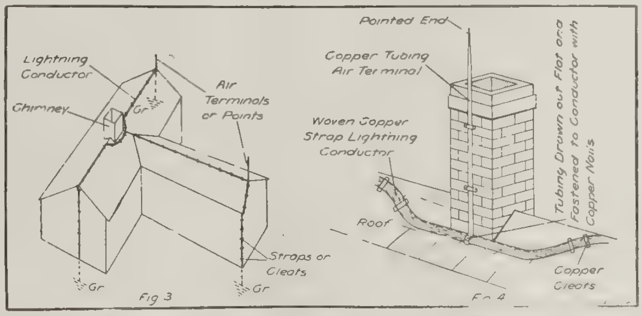


FIG. 3. TYPICAL ARRANGEMENT OF AIR TERMINALS AND LIGHTNING CONDUCTORS ON A BUILDING. FIG. 4. ARRANGEMENT OF AIR TERMINAL AT CHIMNEY OF AN ORDINARY BUILDING.

The statement that *"since heated air is a comparatively good conductor of electricity, it is useless to put lightning rods on chimneys"* is a dangerous one. The writer has in his possession pictures showing damage by lightning to at least a dozen chimneys that were not protected with proper rodding. In some cases the stacks were entirely demolished and in other cases sections have been torn out, or the stacks have been cracked from top to bottom by the lightning discharge current. Where a stack is properly rodded such damage will not occur. Insofar as the writer is aware all of the stacks of the power houses of the different departments of the U. S. Government are protected with very elaborate rodding systems and the practice of protection is followed in all good work. Fig. 5 shows an ideal installation of lightning rod protection for high stacks.

It is true that the heated, carbon-charged gases arising from a chimney do constitute a fairly good path for a lightning discharge current, but it is also true that the current will not in every case follow this path and will in many cases, for reasons that cannot be readily explained, deflect from this heated air conductor and pass down the masonry work of the stack, destroying as it goes. An air terminal should be installed for every chimney of a building (Fig. 4), and a very elaborate system of rodding should be placed on high stacks, such as those of central stations and factories that extend permanently into the air and thereby offer a splendid path to ground for a lightning discharge current.

Oliver Lodge's book, "Lightning Conductors and Lightning Guards," is now considered somewhat out of date, and it is probable that some of the information given in it is

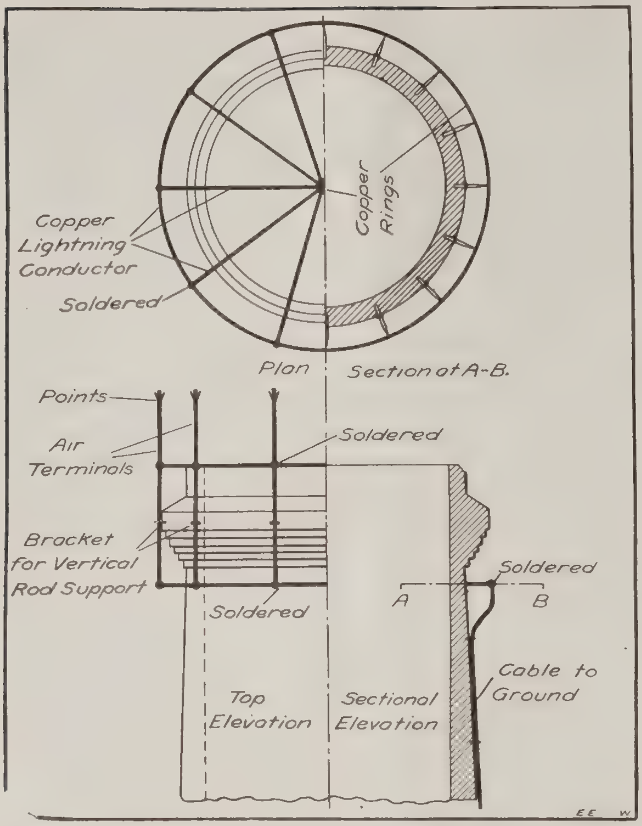


Fig. 5. Arrangement of Air Terminals at Top of U. S. Government Power House Stack.

out of line with the latest and most authentic information on lightning rods. As to statistics proving the effectiveness of properly designed lightning protection, the following may be of interest:

The Farmers' Mutual Protected Insurance Co., of Flint, Mich., insures only rodded buildings and then only after the installations have been inspected and approved. For the four years ending June, 1912, this company carried risks aggregating $55,172,000.00. During that period its total lightning damage amounted to $32.00. The Patron's Mutual Insurance Co., of Michigan, which carries both rodded and un-rodded risks in the same territory as the Farmers' Co., in the same four year period carried risks aggregating $59,567,000.00, and during that period its total damage from lightning was $32,268.00. In other words, the losses due to lightning were 1,000 times as great for the unprotected as for the protected company. If these figures be resolved in the terms used in insurance comparisons, it can be shown that the efficiency of the lightning rods in the case above referred to was 99.91%.

It may further be of interest to note that the above $32.00 damage sustained by the Farmers' Mutual Protected Co., was traceable to defects in the installation of the lightning rod system.

While the installation of a system of lightning conductors, after the plans have been laid out is a simple thing, it is not so simple to design the rodding so that it will be effective. In this matter of design, experience seems to be more important than any other factor, so when a rod installation of any consequence is to be made it is a good investment to consult an expert. Some of the companies that make rodding equipment are very honest and conscientious and have had wide experience and they can frequently be depended upon to offer good advice—provided the buyer does not want to retain a disinterested expert.

Terrell Croft.

Standard Wire Capacities for Conduit.

The accompanying table shows the standard wire capacities of conduit as standardized by the National Electrical Contractors' Association. This information has never, to the writer's knowledge, appeared before in tabular form. It has been given in the charts prepared by the National Electrical Contractors' Association and although these charts are ideal for office reference they are too bulky to be handled conveniently out on a job, hence the writer has incorporated the data from them in the table that is shown. This is compact and can be readily pasted in the wireman's or contractor's notebook.

Terrell Croft.

Standard Sizes of Conduit for Installation of Wires and Cables—Adopted, Recommended and Copyrighted by National Electrical Contractors.

Conduit sizes based on the use of not more than three 90 degree elbows in runs taking up to and including No. 10 wire, and two elbows for wires larger than No. 10. Wires No. 8 and larger are stranded. Special permission is required of the inspection department having jurisdiction for the installation of more than nine wires in the same conduit. The wires used by the telephone companies of various cities differ as to thickness of insulation. The table "A" gives values satisfactory for both light and heavy insulation. For explanation of column heading reference letters for this table A, See foot notes.

Size of Wire		Single Wires			
A. W. G.	Circular mils.	Single Wire	Two Wire System	Three Wire System	Four Wire System
14	4,107	½	½	½	¾
12	6,530	½	¾	¾	¾
10	10,380	½	¾	¾	1
8	16,510	½	1	1	1
6	26,250	½	1	1¼	1¼
4	41,740	¾	1¼	1¼	1½
3	52,630	¾	1¼	1¼	1½
2	66,370	¾	1¼	1½	1½
1	83,690	¾	1½	1½	2
0	105,500	1	1½	2	2
00	133,100	1	2	2	2½
000	167,800	1	2	2	2½
0000	211,600	1¼	2	2½	2½
	300,000	1¼	2½	2½	3
	400,000	1¼	3	3	3½
	500,000	1½	3	3	3½
	700,000	2	3½	3½	
	1,000,000	2	4	4	
	1,500,000	2½	4½	5	
	2,000,000	3	5	6	

Duplex Wires		
Size A. W. G.	Number of Wires	Size of Conduit
14	1	½
14	2	¾
14	3	1
14	4	1
12	1	½
12	2	¾
12	3	1
12	4	1¼
10	1	¾
10	2	1
10	3	1¼
10	4	1¼

A. Conduit Capacities for Various Wires

Conduit	a	b	c	d	e
½	3	10	18	5	3
¾	5	20	30	10	6
1	10	30	40	15	10
1¼	16	70	100	25	16
1½	24	90	130	35	25
2	40	150	200	50	35

Single Wires — Convertible System		
Number of wires-	Size A. W. G.	Size of Conduit
1-	10	¾
2-	14	
1-	8	¾
2-	12	
1-	6	
2-	10	1
1-	4	
2-	8	1
1-	2	1¼
2-	6	
1-	1	1¼
2-	5	
1-	0	
2-	4	1¼
1-	00	
2-	3	1½
1-	000	
2-	2	1½
1-	0000	
2-	1	2
1-	250,000	
2-	0	2
1-	350,000	
2-	00	2½

a—No. 14 R. C. double braid solid wires. Based on straight run without elbows.
b—No. 16 light insulation fixture wires. Based on straight run without elbow.
c—No. 18 light insulation fixture wires. Based on straight run without elbow.
d—No. 20 braided and twisted pair. Switchboard or desk instrument wire. Based on not more than two 90 degree elbows.
e—No. 19 braided and twisted pair. Standard 3/32 insulation telephone wire. Based on not more than two 90 degree elbows.

Questions and Answer from Readers

Readers are invited to make liberal use of this department for discussing questions, obtaining information, opinions or experiences from other readers. Discussions and criticisms on answers to questions are solicited. However, editors are not responsible for correctness of statements of opinion or fact in discussions. All published answers and discussions are paid for.

Generator Would Not Build Up—Why?

Editor Electrical Engineering:

(509) The writer was recently called in to see why a direct current compound wound generator would not operate. I found that the fields were not properly connected. The connections were changed and the machine started and still the machine failed to generate. The shunt coils were then disconnected and the series field windings short-circuited with a fuse. The machine was started and would soon blow the fuse but refuse to build up, even when run above speed. I would like to have some reader explain the probable trouble and how it could be overcome.

J. F. B.

Some Points to Think About.

Editor Electrical Engineering:

(510) I would like to have the following questions published in *Electrical Engineering,* for answer and comment by readers.

(1) Why is it that rotary converters with commutating poles sometimes have a small coil in parallel with the commutating poles, and sometimes not? What is the purpose of these coils, and how do they operate?

(2) What is meant by the interconnected star method of connecting transformers? Where should this connection be used and why?

(3) It is claimed that choke coils of iron wire are far superior to copper for protection against lightning. Is this true?

(4) To what tests should lubricating oils be subjected?

G. D. K.

Winding of Automobile Magneto.

Editor Electrical Engineering:

(511) The writer would like to have some one explain the essential differences in the windings of high and low tension magnetos for automobile engine ignition. Can a low tension magneto be rewound for high tension service without a coil? If so, give the necessary changes.

R. W. O.

Corona and Skin Effect.

Editor Electrical Engineering:

(512) Please explain through the columns of *Electrical Engineering* what is means by "Corona" and "Skin-Effect."

C. A. H.

Action of Partial Ground on Street Railway System.

Editor Electrical Engineering:

(513) I have heard it said that in case of a partial ground or leak on a grounded direct current circuit (a street railway system, for instance) with constant potential, the leakage to ground increases as the load on the line increases. I would like to get the opinion of some readers on this matter.

C. A. H.

Determining Breakdown Voltage of Insulating Material.

Editor Electrical Engineering:

(514) What is the best method for determining the breakdown voltage of insulating materials such as empire cloth, rubber matting, transformer oil, etc? I would like also to know what apparatus is required for this class of work and what particular precautions should be exercised to prevent errors?

C. H. D.

Directions for Winding Small Motor.

Editor Electrical Engineering:

(515) I have a small bipolar motor I would like to rewind so as to operate off dry cells. The armature is $1\frac{3}{4}$-in. diameter by $1\frac{5}{8}$-in. long with eight 5-16 round slots. The field magnet winding space is two inches long by $3\frac{1}{8}$-in. deep. The magnet cores are 1 by $1\frac{1}{2}$ inches.

I have planned to wind the magnet with No. 18 B & S gage wire, using 231 turns per coil. Please advise if this will be satisfactory and how many turns to use on the armature. I have Nos. 18, 20 and 22 wire on hand.

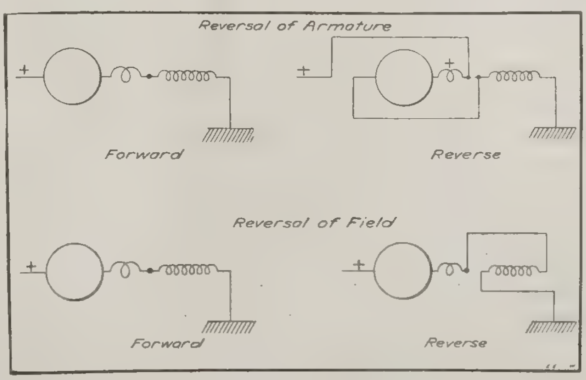
A. L. P.

Comment on Connections for Street Railway Motors. Ans. Ques. No. 482.

Editor Electrical Engineering:

In the December issue the statement is made by K. R. that in railway motors when the field is connected between the armature and ground reversal of direction of rotation of the motor is obtained by reversing the current through the armature. This is not always the case. The question of whether current is reversed through field or armature is influenced by other considerations.

Practically all the old types of controllers reversed the armatures. Since the advent of the commutating pole, however, motors have been generally reversed by field reversal. This reason is similar to the reason for putting the field on the ground side of the armature. The connection between commutating poles and armature is not brought out of the motor case. The armature leads which are brought out of the case come, one from a brush and the other from a commutating pole. Remembering this fact



CONNECTIONS FOR FIELDS OF STREET RAILWAY MOTORS.

the diagrams below will explain the superiority of field reversal. When the armature is reversed, the commutating poles are put on the trolley side of the armature so that their insulation will be subjected to full voltage between trolley and ground. This is avoided by field reversal and the commutating poles are always kept on the ground side of the armature. R. H. Willard.

Calculation of Inductance in Coiled Circuits. Ans. Ques. No. 490.

Editor Electrical Engineering:

For cylindrical coils without iron cores, the inductance in millihenries equals the square of the length of the wire on the coil divided by 400,000 times the sum of the length of the coil, the depth of the winding and the mean ralius, all dimensions to be taken in inches.

A more accurate formula, developed by Professor Morgan Brooks and known as the "Universal Formula," is given in Bulletin No. 53 of the Engineering Experiment Station of the University of Illinois:

$L = [(2\pi\ rn)^2\ F^1\ F^{11}] \div [(l + 1.5d + r)\ 10^6]$

Where L = inductance in millihenries; $2\pi rn$ = length of the wire in centimeters; l = length of the coil in centimeters; d = depth of the winding in centimeters; r = the average radius of the coil in centimeters.

$F^1 = (10l + 13d + 2r) \div (10l + 10.7d + 1.4r)$

$F^{11} = \frac{1}{2} \log_{10} [100 + (14\ r + 7d) \div (2\ l + 3d)$

Six coils were wound, each having 80 turns of wire with an average radius of turn of 1.25 inches. The length of wire on each coil was 52.4 feet or 630 inches. The lengths of the coils (l) were 16, 8, 4, 2, 1 and ½ inches. The depth of winding (d) was 1/10, 2/10, 4/10, 8/10 and 16/10 inches respectively. By the accurate formula of Professor Brooks, the self-inductances are .058; 0.108; 0.186; 0.279; 0.331 and 0.289 millihenries. By the approximate formula given in first paragraph above, the corresponding values are .0572, 0.106, 0.182, 0.276, 0.325 and 0.296 millihenries. The deviation is only about 3 per cent in any case.

Using the approximate formula for the first of these coils, the length of the wire is 630 inches. The square of this is 396,900.

The milli-henries = (396,900) ÷ [400,000 × (16 + 0.1 + 1.25)] = (396,900) ÷ 6,940,000 = .0572.

For the last of the coils given above, the milli-henries equal 396,900 ÷ [400,000 × (0.5 + 1.6 + 1.25)] = (396,900) ÷ (13,400,000) = 0.296.

In order to determine the self-inductance of a coil with an iron core, we must first calculate the number of lines of force set up in the core. For the self-inductance of any circuit in henries equals the product of the number of lines of force per ampere in the coil, by the number of turns of wire (Z), divided by 100,000,000.

Let us, for example, determine the number of turns of wire to place on a laminated iron ring, 3 inches inside diameter, 5 inches outside diameter, 1½ inches long, with a slot cut across one side of ½ inch width. This ring is similar to that in the reactance coil of some kinds of constant potential alternating arc lamps. The apparent section of the gap in the magnetic circuit is 1½ square inches. The lines of force will flare out, an estimated average amount of ¼ inch all around the gap, so that the real section of the gap may be taken as 3 square inches (19.35 square centimeters). The magnetic reluctance of the gap is the length, ½ inch (1.27 centimeters) divided by the section (19.35 square centimeters). The reluctance of the iron may be neglected in this circuit.

The magneto-motive force per ampere is 1.25Z, Z being the number of turns. The magnetic flux per ampere is 1.25Z multiplied by 19.35 and divided by 1.27, or is equal to 19Z. The self-inductance is 19Z multiplied by Z and divided by 100,000,000, or equals (19 Z^2) ÷ 100,000,000.

Suppose, we wish this coil to take 7.5 amperes, effective value, (10.5 amperes maximum, assuming a sine wave) with 60 volts drop (effective value) at 60 cycles. The reactance in ohms must be 60 ÷ 7.5 or 8 ohms. Since $2\pi fL$ is to equal 8 ohms and $2\pi f$ equals 377, L equals .0212 henries. Placing .0212 equal to .00000019 Z^2 and solving for Z, we find Z equals 332, the number of turns of wire.

The maximum flux in the core equals (19 Z × 10.5) or 66, 500 lines. The flux per square inch in the core equals 44,700, which should not overheat the core due to hysteresis and eddy losses. The wire should be given such a cross section that the total losses in the completed coil will not exceed ½ watt per square inch of exposed surface.

Prof. H. P. Wood,
Georgia School of Technology.

Calculation of Inductance. Ans. Ques. No. 490.

Editor Electrical Engineering:

The inductance of a circuit is the number of interlinkages of an electric circuit with the lines of magnetic force of the flux produced by unit current flowing in the circuit and the number of interlinkages of an electric circuit with the lines of magnetic flux produced by unit current in the same circuit, and not interlinked with a second circuit, is called the self-inductance of the circuit. If i = current in a circuit having (n) number of turns, ϕ = the flux produced thereby and interlinked with the circuit, then ($n\phi$) = total number of interlinkages and the inductance, L = (n. ϕ) ÷ i. The practical unit of inductance is the henry, and is 10^9 times the absolute unit or 10^8 times the number of interlinkages per ampere. That is, when a current changing at the rate of 1 ampere per second induces an electromotive force of 1 volt in a circuit an inductance of 1 henry exists. The henry is a very large amount, however, and 0.001 henrys or the milhenry (mh) is generally taken for practically purposes.

Inductance exists in any circuit where the current changes. It is always present in alternating-current circuits and exists in continuous-current circuits at the time of the starting and stopping of current or when the current changes in value.

The most important law in direct-current is Ohm's Law, namely, i = e/r, or e = ir, or r = e/i, where e = impressed emf.; i = current and r = resistance. When an alternating-current flows Ohm's law must be modified because additional counter emfs. are produced by the alternating-current. The equavalent law for alternating-current is, i = e/z, or e = i/z, or z = e/i. Where z is the impedance of the circuit, and is composed of resistance r (as in continuous-current), and reactance x thus, $z = \sqrt{(r^2 + x^2)}$.

If the resistance is strictly ohmic, it will have the same value for both continuous and alternating currents. The reactance x depends upon the frequency of the alternating-current supply, and the inductance and is expressed by,

$x = 2\pi$ f L, where f = frequency of alternating-current and L = coefficient of inductance in henrys.

With this information on hand it is not a difficult matter to calculate the inductance of a coil with or without iron. Knowing the voltage across the coil, the current flowing and the ohmic resistance of the winding, the inductance may be readily calculated. To make the matter clearer, consider the following example.

A coil having a resistance of 2 ohms is connected across a 100-volt 60-cycle circuit. If a current of 5 amperes flows through the coil what is the impedance, reactance and inductance?

The impedance, $Z = E \div I = 100 \div 5 = 20$ ohms.

Now the impedance $= Z = \sqrt{(R^2 + X^2)} = \sqrt{(4 + X^2)}$ Therefore $X^2 = \sqrt{(Z^2 - R^2)} = \sqrt{396}$, and $X = 19.9$ (apx).

But $X = 2\pi fL$ therefore, $L = X \div 2\pi f = 19.9 \div 2\pi f = 52.7$ milhenrys.

Having discussed the methods for obtaining the inductance of a coil by measurement of the current flowing, we will now show the means for determining the inductance from the number of the turns and the shape of the coil. It is surprising what a large amount of literature exists dealing with the inductance of coils and solenoids of various shapes and sizes. The reason of this is that a given length of conductor has a definite resistance but may have as many different values of inductance as there are shapes, and each different shape of coil requires a different formula for determining the inductance, although several of the so-called universal formulae are accurate enough for many coils of very different shapes and sizes.

It has already been pointed out that the coefficient of self-inductance of a winding is the product of the turns of the winding and the number of lines which those turns embrace when carrying unit current, and it is upon this equation that all the formulae for the calculation are founded. Expressed in another way, the inductance of a coil is the constant ratio existing between the counter-electromotive force and the rate of change of current.

For example: Find the inductance of the field of an alternator having 18 poles when each field spool has 600 turns, and the spools are all connected in series, with 7 amperes producing 6.5 megalines per pole.

The total number of poles $= 18 \times 600 = 10800$. As each is interlinked with $(6.5 = 10^6$ lines, the total number of interlinkages at 7 amperes is $10800 \times 6.5 \times 10^6 = 70 \times 10^9$.

Now 7.0 amperes = 0.7 absolute units, hence the number of interlinkages per unit current is,

$L = 70 \times 10 \div 0.7 = 100$ henries.

The Bureau of Standards has obtained much valuable information on mutual and self-inductance, but unfortunately, the formulae are so complicated as to require more time for study than the average engineer is able to spare. It has been seen that short coils require different formulae to long coils, although there is no hard and fast rule as to when a coil is short or long. A coil is considered to be short, however, when its axial length is less than its outside diameter. Short coils have higher inductance than long coils with a given length of conductor.

A simple formula for a coil of one layer is given by, $L = (4\pi\ A\ N^2\ l) \div 10^9$ in henries.

Where A = cross section, l = length of coil, and N = the number of turns per unit length, r = internal radius, t = thickness of winding.

For a coil having several layers the inductance is given by, $L = [4\pi^2\ N^4\ l\ t^2\ v^2\ (1 + t \div p + t^2 \div 3r^2)] \div 10^9$ in henries.

When a coil contains iron the inductance is approximated by, $L = \vert(4\pi^2\ u\ N^4\ l\ r_1^2\ t^2 \div 10^9{}_1$ in henries. Where r_1 = radius of iron core.

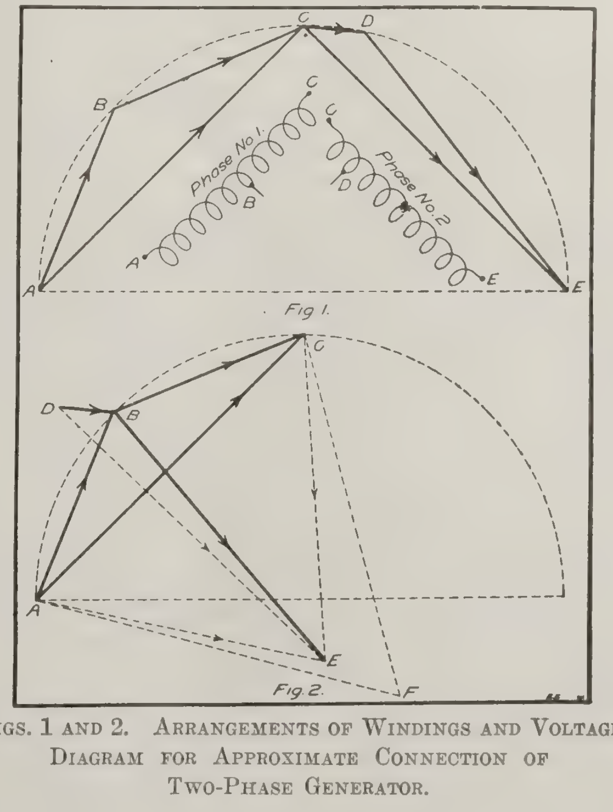
It is impossible to use any one formula to give the inductance accurately for coils of any shape and number of turns. If the querist desires to study this subject I recommend the following works: "The Electric Circuit" and "The Magnetic Circuit" by V. Karapetoff. Bureau of Standards Bulletins 80. The Self and Mutual Inductance of Linear Conductors, by Edwin B. Rosa; 169. Formulas and Tables for the Calculation of Mutual and Self Inductance. (Second edition, revised and enlarged) by Edward B. Rosa and Frederick W. Grover.

Ivon L. Kentish Rankin.

T Connection With Two-Phase Generator. Ans. Ques. No. 491.

Editor Electrical Engineering:

Transformers connected in "T" have been used for many years for transforming from two-phase to three-phase or vice versa and are entirely satisfactory for this purpose. Any ordinary lighting transformers may be used provided they are two coil transformers and that one of them has an 86.6 per cent tap. The primaries of these transformers are then connected directly across the two-phase supply and the secondaries are "T" connected; that is, the 86.6 per cent tap on one secondary is connected to the middle point of the other secondary. The result is that the potentials across the three leads remaining are equal and 120 degrees apart in phase, which satisfies all the conditions of a three-phase supply.



FIGS. 1 AND 2. ARRANGEMENTS OF WINDINGS AND VOLTAGE DIAGRAM FOR APPROXIMATE CONNECTION OF TWO-PHASE GENERATOR.

Now as to the "T" connection of a two-phase generator. It might appear upon first thought that a three-phase supply can be obtained from it in the same way as from the transformers. There is this difference, however. In the transformer the potentials between a tap and the outside leads are in phase with each other and with the total voltage between the terminals of the transformer. In the generator the potentials between the terminals of a phase winding and a tap in the phase are not in phase with each other, and neither of them is in phase with the terminal voltage of the coil in question. This is best illustrated by Fig. 1. The line AC represents the voltage of phase 1, and the line CE the voltage of phase 2. They are equal to each other and 90 degrees apart in phase. In the diagram of the windings shown, B is a tap to the mid-point of phase 1, and D is an 86.6 per cent tap on phase 2. The potential between A and B instead of being equal to one-half of AC, and in phase with AC, is represented by the line AB both in phase and in magnitude. In the same way the potential between B and C is represented by the line BC, that between C and D by the line CD, and that between D and E by the line DE. To make the "T" connection for this generator, the points B and D would be connected together, and A. C. and E would be the terminals from which we might expect to get a three-phase supply. Just how far this falls short of being a three-phase supply is shown by Fig. 2, where AC, CE and EA are the three potentials that nearest resemble a three-phase supply. It is easily seen, however, that they are not equal, neither are they 120 degrees apart in phase. If AC is 100 in the diagram, CE would be 88, and EA would be 78.

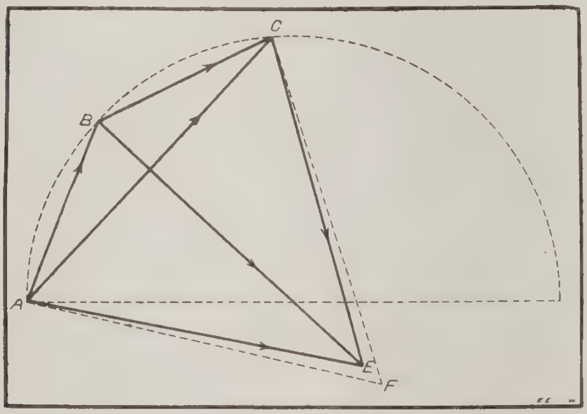
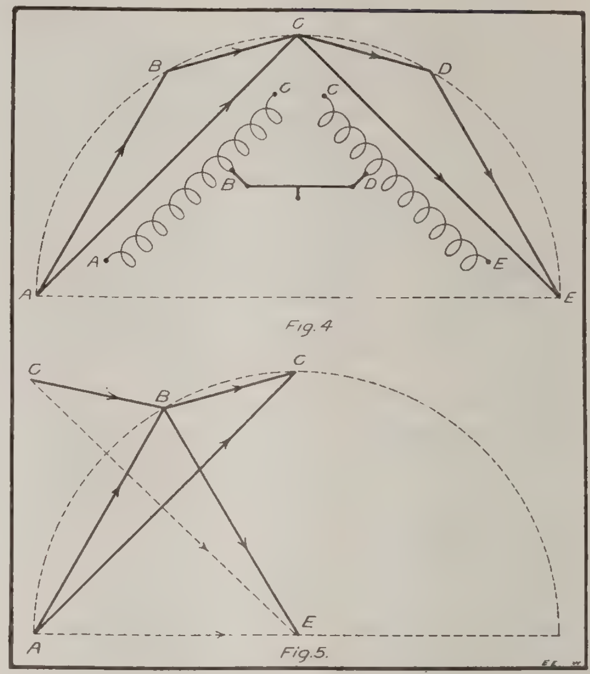


Fig. 3. Voltage Diagram for Another Approximate T Connection for Three-Phase Supply.

A better way to "T" connect the machine, and one that would give a closer approximation to a three-phase supply would be to connect B to C. The voltages available with this connection are shown in Fig. 3, but this would still not give a three-phase supply. The voltages available are AC, CE and EA. The triangle ACF in both Figs. 2 and 3 shows just how far each connection fails of the desired result.

It should not be inferred, however, that it is impossible to inter-connect the windings of a two-phase alternator so as to carry both two and three-phase loads from the same machine. Fig. 4 represents the windings of a two-phase machine in which B and D are 66.6 per cent taps. The phase relations of the four parts into which the windings are now divided are shown by AB, BC, CD and DE in the diagram. By connecting B and D together and bringing out a lead from the junction of these two points, a true three-phase supply may be obtained from this lead and the leads connected to A and E. Fig. 5 shows the phase relations of all the different voltages available when the machine is so connected. AB, DE and AE are the three-phase voltages, all of which are equal to each other, and 120 degrees apart in phase. The coils that supply the three-phase load are connected in open delta and consequently have only 86.6 per cent of their original capacity. The scheme would be practical only for laboratory or experimental work. It would not be advisable to attempt to apply it to existing two-phase machines. Transformers would be necessary for a case of this sort. It should be noted that the three-phase voltage thus obtained is not equal to the two-phase voltage and if this should be one of the requirements there seems to be no possible connection that would suffice.

F. J. Rankin.



Figs. 4 and 5. Arrangements of Windings and Voltage Diagram for Securing Best Approximation of Two and Three-Phase Supply From Two-Phase Machine.

T Connection for Two-Phase Generator. Ans. Ques. No. 491.

Editor Electrical Engineering:

It is the opinion of the writer that the T connection of the windings of a 2-phase generator to secure 2-phase and 3-phase supply would be impracticable. Such a connection would give a 3-phase, 3-wire system with the center wire serving as a common wire for each phase. Such a 2-phase system of distribution is sometimes found. The phase displacement still remains 90 degrees, however, instead of 120 degrees as in a 3-phase system.

If the connection is made, that shown in the accompanying diagram would probably work best. Connect the end of the winding of phase *A* to the center of phase *B*. Bring out a tap on phase *A* at such a point on the winding that 86 per cent of the winding will lie between it and the junction with phase *B*.

The three-phase connection will then be secured from leads 2—2'—3. The two-phase connections from leads 1—1' and 2—2'.

Charles E. Beckwith.

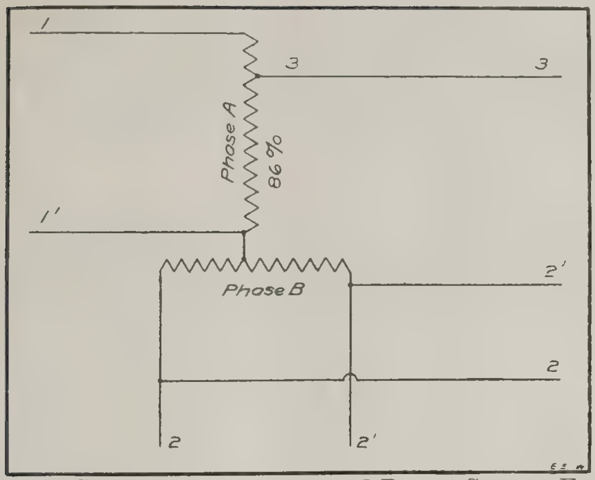


FIG. 1. CONNECTIONS FOR 2 AND 3-PHASE SUPPLY FROM 2-PHASE GENERATOR.

Use of Electric Iron on Controlled Circuit. Ans. Ques. No. 492.

Editor Electrical Engineering:

Enough detailed information is not given in question 492 to give full answer. If the controller is intended to limit the load on the circuit with which it is used to 220 watts, it would undoubtedly open the circuit when an ordinary flatiron is connected to it. The controller might be a fuse, a circuit breaker, or some electro-magnetic device to interrupt the supply when a certain predetermined current is exceeded. It is undoubtedly quite safe to use two 500 watt irons on an ordinary circuit, installed according to code rules, but it is not permissible. The two irons would not draw over ten amperes and this is less than is allowed for No. 14 rubber-covered copper wire. If lights are to be used on the same circuits as the irons, it would be necessary to have two separate circuits. However, if a circuit is to be installed for the irons alone there is nothing in the code that would prevent their use on the same circuit. The receptacles used should be approved for 500 watts, and a strict enforcement of the rules would require a fuse to protect each iron; that is, at the point where the iron is tapped on to the circuit, but I do not believe this would be required in most cases.

Line Loss With Fluctuating Load. Ans. Ques. No. 498.

The energy lost in any power circuit, whether direct or alternating current, is proportional to the average of the square of the instantaneous values of current and not to the square of the average value of the current flowing. By taking the average of the square of the current flowing at equal intervals throughout a given period and multiplying this by the line resistance, the result obtained would be very close to the rate at which power is being lost in the line.

Trouble With Watt Meter on Arc and Induction Motor Circuit. Ans. Ques. No. 499.

This trouble must be due to a wrong connection in the watt-meter. Either a current or potential coil is reversed. The meter should run in the proper direction with any combination of the loads mentioned. Check up the meter connections very carefully and you will undoubtedly find the trouble. A poly-phase watt-meter properly installed will register all the power used on a three-phase circuit regardless of the nature of the load.

Number of Lightning Arresters for 2,200 Volt Service. Ans. Ques. No. 501.

The number of lightning arresters required to protect a 2,200 volt, 3-phase transmission line three miles long depends largely on the nature of the country in which the line is located. Arresters at the transformers, at the motor and in the middle of the line would be sufficient for most cases. Thirteen arresters to each of the lines mentioned would certainly not be necessary, though they would not do any harm. There would not be any danger in the arresters grounding the line unless some of them became defective. Many lines of this length are installed without any lightning protection whatever, though it is not good practice.

F. J. Rankin.

Electric Iron on Controlled Circuit, Ans. Ques. No. 492.

Editor Electrical Engineering:

As I understand the situation, the controller is set for 300 watts load and a load of 500 watts is to be connected to the circuit. The controller would probably operate continuously during the time the excess load was active. The effect on the controller of this continuous action would depend upon the design of the moving parts and contacts, and the size of the wire composing the solenoid windings. That is, assuming that the controller has a continuous-load rating of 660 watts, and can be adjusted to operate at various loads between the limits of 300 and 660 watts. A load of 500 watts could be used continuously upon the controller without overheating the windings, but if the continuous-load rating of the controller is 300 watts, a load of 500 watts would probably overheat the controller windings, causing its early destruction.

A similar condition exists concerning the moving parts and the contacts, as the effect of the continuous overload is dependent upon the design of these parts. If the controller is of the type that alternately makes and breaks the main line many times a minute during the period of overload, the attempted use of the 500 watt load would probably destroy the contacts through arcing and pounding. If the controller is of the type that inserts a resistance in series with the line, then the question reverts to the current carrying capacity of the resistance.

The effect of the controller action upon the electric iron would depend upon the ratio of the effective value of the reduced voltage to the rated voltage of the iron, the heating value varying as the square of the voltages. A more definite answer to this portion of the question cannot be given with the information supplied.

As to the second portion of the question. The simultaneous use of two 500 watt electric irons, or a 1000 watt load, on a circuit wired according to the code for 660 watts is not permitted by the underwriters and, hence, is not safe.

The proper method to follow is to have a separate circuit for each iron from a source of at least 1000 watts capacity according to the code rating.

R. Arthur Joslyn.

Use of Electric Iron on Controlled Circuit, Ans. Ques. No. 492.

Editor Electrical Engineering:

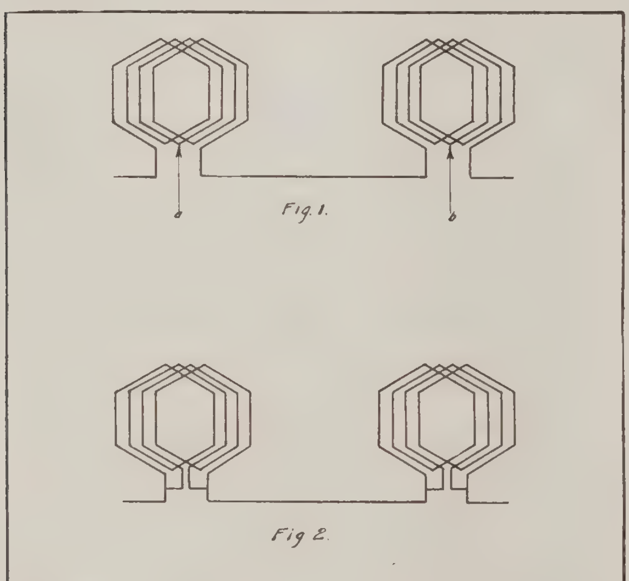
In answering question 492, it is assumed that carbon filament lamps are being used, each requiring approximately 55 watts. Therefore if a controller is in use which allows only 6 lamps to be used at one time, the maximum service supply allowed must be in the neighborhood of 330 watts, so that a 500 watt iron or any other device consuming more than 330 watts would cause the controller to operate the same as if an attempt were made to use more than 6 lamps

at one time. If an intermittent type of controller is installed, a 500 watt iron connected to the circuit will cause it to interrupt the circuit with considerable rapidity at such frequent intervals that not enough current will flow continuously to heat the iron.

It is not permissible to operate two 500 watt irons or any other devices requiring that much power on a circuit installed according to the code ruling to carry a load of not over 660 watts on a single cutout. If such a circuit were properly fused the fuses would undoubtedly blow with the two 500 watt irons connected as there would be a 50 per cent overload on the circuit. It is highly possible to put in heavier fuses and operate the circuit with the 1,000 watt load but under no conditions should this be done. The proper procedure would be to install a so-called "heater circuit" which is a circuit supplying only the heating devices it is desired to operate and served by an individual cutout.

Changes to Operate a 440 Motor on 220 Volts. Ans. Ques. No. 493.

In regard to question 493, it is usually possible to reconnect a 440 volt motor such as mentioned, for 220 volts by opening the windings as at points (a) and (b) Fig. 1, and reconnecting the coils in parallel as in Fig. 2. Figures 1 and 2 show the coils of two poles for one-phase of a three-phase motor and most 440 volt motors are designed so the coils are in series for each pole as shown in Fig. 1 and can



FIGS. 1 AND 2. DIAGRAMS FOR 440 VOLT AND 220 VOLT WINDINGS.

be reconnected in parallel as in Fig. 2 for 220 volts. However, this connection can only be made when there are an even number of coils per pole, per phase. That is, 2, 4, 6, 8, etc. The question does not give the number of poles of the motor under discussion so it is not possible to say whether it can be readily reconnected with its five coils per pole per phase or not. C. A. Purdy.

Changes in 440 Volt Motor for 220 Volt Operation. Ans. Ques. 493.

Editor Electrical Engineering:

In the absence of sufficient data, it will be necessary to use general formulas to answer question 493 or give an example from standard machines. The writer has the following data at hand and will give it to illustrate a method D. H. may use.

Assume that we have a motor of 35 h. p., 440-volts, 45 amphere, 3-phase, 60-cycle, 900 r.p.m. The machine is constructed as follows:

Internal diameter of stator	19 in.
Frame length	4.5 in.
Slots, number	96
Slot size	0.32 x 1.5 in.
Conductors per slot, number	8
Conductor size	0.1 x 0.2 in.
Connection	Y

It is required to rewind for 220-volt, 3-phase, 60-cycle.

Conductors per slot. From the electro-motive force formula $E = 2.222\ k\ Z\ \phi\ f\ 10^{-8}$ volts, where (k) is the distribution factor and is equal to (0.956) for three-phase windings; (Z) is the number of conductors in series per phase; (ϕ) the useful flux per pole, and (f) the frequency. $=$ a const. $\times$ K $\times$ (cond. per slot $\div$ phases) for a given frame and frequency.

For the machine in question k = 0.956 and the constant = (volts per phase $\times$ phases) $\div$ (K $\times$ cond. per slot)

$$= (440/\sqrt{3} \times 3) \div (0.956 \times 8) = 100$$

The windings data may be tabulated thus:

Terminal emf.	440 volts	220 volts
Phases	3	3
Volts per phase	254	127
Conductors per slot	8	4
Connection	Y	Y*

*To fit the 220 volt winding in the 440 volt frame use 8 conductors per slot and connect them Y-Y.

Size of Conductor. This must be chosen so that the stator copper loss and copper heating are the same for each voltage. That this may be the case, it is necessary to keep the ratio (amp. cond. per inch) to (cir. mils per amp.) a constant. The work can be carried out in tabulated form thus:

Terminal emf	440 volts	220 volts
Phases	3	3
Current per terminal	45	90
Current per conductor	45	45
Conds. per slot	8	8
Connection	Y	YY
Amp. cond. per inch	580	580
Cir. mils per amp.	560	560
Conductor size	0.1 x 0.2	0.1 x 0.2

How each of the above values are obtained where not given in the data, is easily seen and needs no explanation.

From the above it is seen that it will only be necessary to change from Y to Y-Y to meet the reduced emf. This is the standard method of procedure used by makers to fit a certain motor for several potentials. It is unnecessary to alter the rotor.

The Electron Theory of Magnetism, Ans. Ques. No. 496.

Bulletin No. 62 of the University of Illinois Engineering Experiment Station very clearly sets forth the Electron Theory of Magnetism. There are no books treating upon this theory that do not require the use of calculus in thoroughly understanding the subject. The main idea of the theory will be found on page 5 paragraph 3 of the above bulletin and contains no mathematics. This bulletin is free and can be secured by writing the University of Illinois Experiment Station, Urbana, Ill.

H. E. Weightman.

ELECTRICAL ENGINEERING

DANIEL H. BRAYMER, Editor.

Devoted to the generation, transmission and distribution of electrical energy for lighting, heating, power and traction. Correspondence suitable for the pages of ELECTRICAL ENGINEERING is solicited and paid for. Name and address of correspondents must be given,—not necessarily for publication.

Published monthly by the W. R. C. SMITH PUBLISHING CO., at Dalton, Ga.; editorial and advertising departments, Grant Building, Atlanta, Ga. Entered as second-class matter at the postoffice at Dalton, Ga. Subscription rate $1.00 for two years; Canada $1.00 a year; foreign $1.50 a year.

Vol. 47. MARCH, 1915. No. 3

CONTENTS.

Celebration of a "National Electrical Week" as a prosperity week is an event scheduled for 1916.

The Society for Electrical Development is enlisting the cooperation of all affiliated interests in the electrical industry with national manufacturers and civic bodies to promote better lighting of streets, stores, factories, schools and houses. The object is to show how general business may be advanced by more general use of electricity.

On January 25, 1915, Alexander Graham Bell, the inventor of the telephone, seated at a telephone in New York City said Hello! to Thomas A. Watson, an old time assistant, who was seated at a telephone in San Francisco. A regular telephone conversation was held between these two men on this date over 3,600 miles of telephone line.

In 1849, transcontinental travel between New York and San Francisco consumed five months by stage coach. In 1859, by sailing vessel around Cape Horn it required three months. Ten years later the railway bridged the distance in twenty days. The opening of the Panama Canal in 1914 made it possible to do the journey in sixteen days by steamship, while the beginning of 1915 shows a railway record of 71 hours and 27 minutes. By transcontinental telephone line a man's voice reaches the far end in one-fifteenth of a second.

The Value of Wood as Fuel.

The heating value of wood as fuel can be found in most engineering handbooks and works on operation of steam boilers. The pet statement seems to take the form that the heating value of dry wood varies from 6,000 to 9,000 B.t.u. per pound, supplemented by the remark that wood as a fuel is rapidly dropping out of use. A searcher for more definite and specific information and data on wood burning in a boiler furnace is at once discouraged, for practical data of a reliable nature on the economical combustion of wood is still wanting. The information on the burning of coal, oil and other common fuels according to tests and regular practice, if one is to judge by the volume of such, seems to prove that wood as a fuel for a boiler furnace is decidedly a back number, and places the searcher in the same mental condition as for instance, when he begins to look for data on the use of a simple steam engine under conditions now calling for the steam turbine.

This state of affairs is unfortunate for when the investigator makes a tour of certain sections of the country where timber lands have been and are being cut over, and observes the quantities of wood going to waste, being shipped and used in boiler furnaces, the thought at once presents itself that this wood must have some general value as a fuel as against high priced coal and that the engineering side of this subject must have been overlooked. Without question a great service can be rendered present cord wood and wood refuse burners by the collection and presentation of reliable engineering and test data on this subject, for with small wood burning plants located where wood is available and even where wood is going up in price on account of reduction of supply, it is an economic problem more vital now in point of plant economy than ever before, to know approximately the price of wood that makes it more economical to remodel or replace furnaces and begin to burn coal.

Recent experiments in the laboratories of the government forest service are of value in this connection, even though the data given out refers to the value of wood as burned in stoves for heating and cooking. These experiments seem to indicate that the average heating value of dry wood is around 8,250 B.t.u. per pound. With the average run of air dry cord wood containing 20 per cent moisture, the fuel value of two pounds of this wood is roughly equal to that of one pound of the average grade of good coal. That is a coal with a heating value around 13,500 B.t.u. per pound as fired. The tests seem to show further that one cord of air dry or seasoned oak, hickory, birch, hard maple, ash, elm, longleaf pine and cherry has a heating value about equal to that of one ton of good coal. The heating value of one and a half cords of such

woods as shortleaf pine, hemlock, red gum, Douglas fir, sycamore and soft maple is given equal to one ton of coal while it takes two cords of cedar, redwood, poplar, cypress, basswood, spruce and white pine to furnish heating units equivalent to the one ton of coal referred to as the standard.

These results seem to check with the data given in Kent's handbook where it is claimed that about $2\frac{1}{4}$ pounds of dry wood are equal in heating value to one pound of average quality of soft coal. These figures seem to indicate then, that if wood can be secured for $2.00 per cord in an air dry condition, it can be burned in a properly designed furnace in competition with $2.50 soft coal averaging 12,500 B.t.u. per pound. With coals of higher heating value obtainable at this price, the price that can be economically paid for wood per cord becomes less. About $1.75 is the maximum amount that can be paid for wood when coal of 13,500 to 14,000 B.t.u.'s can be secured at $2.50 per ton.

In the wood burning districts of Florida, Georgia, Mississippi and Louisiana, where the price of wood varies from $1.50 to $3.00 per cord, successful boiler operation seems to be possible in competition with Alabama grades of soft coal varying in price from $3.00 to $5.00 per ton.

The greatest drawback to wood as fuel is its variable moisture content. When wood contains more than 25 per cent by weight in moisture, it has not only to vaporize the water formed from its hydrogen of combustion but also has to vaporize the moisture content. Suppose wood to be ordinarily dry that is air dried and containing around 20 per cent of water. If this wood when perfectly dry could evaporate 4 pounds of water per pound of wood, in its firing condition, it has only four-fifths of this power or can evaporate only 3.2 pounds. It already carries one-fifth of its weight as water which must be evaporated so that the available power is 3.2 pounds less one-fifth pound or 3.0 pounds. This makes the value of wood containing 20 per cent moisture about 75 per cent of its dry value, which shows the importance of securing wood as dry as consistent with the price paid.

From these remarks, we believe it is plain that wood burning cannot be carried on under even average conditions with economy by "rule of thumb" methods of buying and firing and that here is a work for some ambitious engineer to do something for his fellow workers.

The Square Peg and the Square Hole; Not the Square Peg and the Round Hole.

The employes of any concern may be divided into two groups: Those who are satisfied with their positions and faithfully performing present duties with the desire to climb higher and those who simply work from pay day to pay day, the regulation number of hours with no particular desire or ambition in regard to a definite place in any organization or the industry of which they provide the human element. The first class is on the road to success and all that need be said in way of encouragement is, "Keep doing your best and studying the job of the man ahead of you. If he is growing in his position he will soon move up, then be ready for the vacancy." As to the second class, we call attention to the following remarks in a recent issue of *Current Opinion* by a man (his name does not really matter—but it is Theodore J. Goe), who in a homely philosophy gives some good hard-headed advice to laborer, manager and executive, whenever the services of such are being paid for with other people's money. Mr. Goe says:

"As a general thing, in so large a percentage of cases that the exceptions may well be ignored, every man fits the thing he is doing; which means that he couldn't do anything better, and would be no more successful if he shifted to something else.

"Success comes not because of the nature of the business in which a man is engaged but of the nature of his efforts to make it succeed. A successful man is generally a happy man, but he was happy before he was successful. He was happy in his work because he found ways in which to make it interesting and enjoyable. Hence he worked hard, had a good time while he worked, and eventually found himself in the front rank where hard and happy workers always arrive.

"Your business fits you. There isn't much room for doubt that it fits you better than anything else would. You may say it is the most difficult, disagreeable, unprofitable and altogether hopeless occupation that any intelligent human ever engaged in. But the fact that thousands of other men in practically every business known to mankind are saying the same thing proves that you are wrong. Anything that is worth doing at all can be done in a way to make it enjoyable and successful. Even if a man makes only wooden toothpicks, he can study out ways to pack them better, to make them more shapely and smooth, to render them aromatic, or to invent machinery that will produce them more cheaply. And every man has it within his power to experience the rare joy of contriving means to elbow competition out of desirable territory and hunch it along by easy stages until he can chase it over the horizon, so that it may be seen no more by men in that region.

"There is one thing, though, that you may as well understand now as at some other time—better now, because some other time may be too late. *You will never be the real big thing in your line; you will never have as much fun as you might have; you will never make the money you are entitled to; and you will always be number two, if not number twenty-three, unless you play the game fair and square.*"

Probably the reader of these remarks is devoting his time to some phase of the electrical industry. If this advice suggests anything at all, it says to you, "Go and do the next job turned over to you better than any you have ever done before and at a lower cost to your employer in labor and material;" "Go you and operate the plant in your charge on less coal and produce a kilowatt hour at less cost." To you, Mr. Manager, it says, "Pay a fair wage, get the confidence of those who serve you; deliver a good product at a fair profit and your dividends will increase;" and so among all of us, these few remarks from the pen of a man who began as a printer's devil and is now a power in the advertising field, should strengthen good resolutions into something definite as measured in personal success.

There is no combination of man and business or men and vocations which justifies the time worn expression of "A square peg in a round hole." The combination in all cases is akin to a square peg in a square hole or a round peg in a round hole, the peg in every case being too small, just the right size, or too large. Every business and every industry is made up of a lot of pegs and a lot of holes and it's the personal duty of every man to peg himself into the hole that he fits now until he is sure that he fits some other better. In this way any man can climb up in this world just as high as his ability will carry him and this is as high as it is safe to go—for such a man it's the place called success.

Concerning the Electrical Trade

News of Activity by Jobbers, Dealers, Contractors, Central Stations and Manufacturers.

James Clark, Jr., Heads South's Largest Electrical Manufacturing Company and Conducts Large Jobbing Business.

Some 23 years ago the firm of Cooper and Clark operated a small repair shop at 313 West Main Street, Louisville, Kentucky. Growing out of the work of this organization, there exists today in Louisville, the South's largest electrical manufacturing company, conducted under the name of James Clark, Jr., Electric Company in connection with a large jobbing business with a main office at 520 West Main Street, a factory on Bergman Street, and branch offices in Chicago, Pittsburgh, Philadelphia and New York City. Beginning in a modest way with three or four people, this organization now employs about 200, and besides being the largest manufacturer of electrical tools in the South, turns out a product that competes favorably with other manufacturers in this country and abroad.

The James Clark, Jr., Electric Company is headed by Mr. James Clark, Jr. Mr. Clark was born in Louisville, Ky., August 29, 1869, of Scotch parentage. He was educated in the public schools of Louisville and later attended the Massachusetts Institute of Technology at Boston, where he received the degree of Bachelor of Science in electrical engineering in 1890. After graduating he returned to Louisville and secured a position with the Ohio Valley Telephone Company, which position he held for about a year and a half, leaving early in 1892 to enter the electrical contracting business as a partner in the firm of Cooper and Clark. In the early days of this company Mr. Clark superintended the installation of a number of extensive wiring installations, isolated plant and municipal plant equipments. The work called for the establishment of a repair shop, which was the real cause for the company getting started along electrical manufacturing lines. The first electrical equipment made was electric fans. Gradually a line of small dynamos and motors was developed especially suited for driving machine tools. Mr. Clark was among the first to appreciate the value of strictly electrically driven machines and tools where the motor is a component part of the machine or tool, properly designed and proportioned for the particular work of the tool and an integral part of same. Fortunately he secured as a co-worker in this line of manufacture, Mr. C. E. Willey, who has been responsible for a large part of the design and manufacturing details of the electrical apparatus now made by the James Clark, Jr., Electric Co. This apparatus bears the name Willey and includes motor driven portable electric drills, drill presses, grinders, winding machines, electric hoists, crane motors, elevator motors, and a line of direct and alternating current motors and generators for general power and lighting requirements.

In 1894 the interest of Mr. L. H. Cooper in the firm of Cooper and Clark was purchased by Mr. James Clark, Jr., and the business conducted under the name of James Clark, Jr., and Company until 1907 when it was incorporated under the name of James Clark, Jr., Electric Co. During that year the main offices were transferred to 520 West Main Street, the location at 313 West Main Street being used as a retail electrical supply store.

While Mr. Clark handles the entire commercial end of the business, he finds time to devote to his hobby, that of raising flowers, both out of doors and in a hot house and his efforts along this line are as successful as in all others. He is a director of the Louisville Board of Trade, Member of the American Institute of Electrical Engineers, the Rotary Club, Commercial Club, Tavern Club, Louisville Country Club, and first Tribune of the Jovian Order in Louisville.

James Clark, Jr., President James Clark, Jr. Electric Co.

The company is a member of the Merchants and Manufacturers' Association of Louisville, the Engineers and Architecas' Club of Louisville, the American Supply and Machinery Manufacturers' Association, the Electric Power Club, the Electric Supply Jobbers' Association and Society for Electrical Development.

In October, 1903, Mr. Clark was married to Miss Inda Helm, daughter of Mr. James P. Helm, a prominent corporation lawyer in the state of Kentucky. Her grandfather was a former governor of Kentucky and her uncle, Mr. B. Hardin Helm, a confederate soldier and leader of the Orphan Brigade during the Civil War. Mr. and Mrs. Clark have two boys, one six and the other four years of age.

The James Clark, Jr., Electric Company carries an extensive stock of electrical supplies of different manufacturers for whom they act as jobbers. A 950 page supply catalog is issued regularly, known as the Clark Blue Book. The catalog lists the following lines:

Rubber Covered Wire—
B. F. Goodrich and Co., Akron, Ohio.

Wiring Devices and Schedule Goods—
Bryant and Perkins Electric Co., Bridgeport, Conn.

Switches and Panel Boards—
Mutual Electric & Machine Co., Wheeling, W. Va.

Fuses and Cutouts—
Detroit Fuse and Mfg. Co., Detroit, Mich.
Electrical Instruments—
Weston Electrical Instrument Co., Newark, N. J.
Heating and Cooking Devices—
American Electric Heating Co., Detroit, Mich.
Incandescent Lamps—
Colonial Electric Co., Warren, Ohio.
Electric Fans—
Colonial Fan and Motor Co., Warren, Ohio.
Fixtures and Portables—
Faries Manufacturing Co., Decatur, Ill.
Dry Batteries and Flashlights—
Nungesser Mfg. Co., Cleveland, Ohio.
National Carbon Co., Cleveland, Ohio.
American Everready Co., New York City.
Street Lighting Fixtures—
George Cutter Company, South Bend, Ind.

The officers of the James Clark, Jr., Electric Co., are as follows: James Clark, Jr., president and treasurer; C. E. Willey, vice-president and factory superintendent; Walter S. Clark, secretary and assistant treasurer.

Ross B. Mateer, Commercial Agent, Southern Sierras Power Company (Cal.) Comments on a Question of Policy in Securing Pumping Loads.

It frequently occurs in the general rush for business by central stations, especially of an agricultural character, that the consumer is advised to install equipments that are much too large for his use. Such apparatus is perhaps the result of the farmer's idea that he desires a large quantity of water, which idea is plausible, since after assuming the expense of drilling a well, and same has been tested for a mean average flow, the tendency is to secure, if possible, a little more than best operating conditions will show. Again, a large pumping apparatus may also be the result of an ambitious salesman, whose commission largely depends upon the magnitude of the sale and the farmer, who has advanced the idea of a maximum quantity of water over a given period, is frequently encouraged to put on his well a pump and motor that will fulfill the desires and wishes of the ranchers. It is of such installations that a little criticism may result in an effort on the part of central station to convince the farmer that best operating efficiency depends—not upon securing a maximum quantity of water over a short period of time—but an average quantity of that precious fluid over a longer period of time.

It is well to bear in mind that once the rancher tills his soil with a view to growing alfalfa, which product demands water and plenty of it, he should be led gently as it were, along the paths of efficiency and not permitted to blindly purchase and install a motor operated pumping equipment, which in the near future results in a complaint as to the cost of service or the supplanting of electric service with internal combustion units.

It is of such consumers of current, permitted to blindly work against their own best economical conditions, that the central station has the most to engross its attention at this time of the year. It is of such users of electric current that the public utility, seeking the confidence of the public, has the most to fear. Hence it is with the agriculturalist who has the large pumping unit operating over a minimum period each month that the greatest amount of attention and labor must be expended if the revenue accruing from the sales of current is to not only hold its own with that of the previous year but to increase through the installation of an additional pumping equipment.

The remedy is a comprehensive study of present consumers of current, their feelings toward the company and the apparatus used in their daily pursuit of profit through the tilling of the soil. Such an investigation demands not a mere casual inspection of the pumping plant, but the working out of an operating situation whereby water may be pumped—perhaps in smaller quantity—but over a longer period of time, which condition will result largely in the customer then availing himself of those rate schedules which result in either a reduced cost of operation or more service for the same amount of money expected. Too much care cannot be given to the man who is dependent upon electric service for the cultivation of his land, especially if you would have him as a "booster;" for he is the one who, making a success of a certain acreage, will inform his neighbor, and he in turn, his neighbor, and the result is a good daily load factor, a steadily increasing revenue, and what is more of value to any public utility, the co-operation of consumers and company.

Large installations may be satisfactory where they are so arranged as to work in at different periods of the day or month and result in a good average load, but where operating conditions may at the expense of a little effort be improved, even though it is against the wish of the agriculturalist who has been led, perhaps, by the promoter of any particular section to place his confidence and faith in something that is large, be it a motor or an engine, the smaller plant is superior. It is a well known fact that the farmer who makes the most from the land which he cultivates, is the one who plows deep and who cultivates a small acreage intensively, maturing two or three crops per year, utilizing the soil, as it were, for the entire twelve months' period. Why not, then, discourage a large unit used for the lifting of water, the extensive acreage which a man endeavors to hold and skims over the top only, encouraging, if you please, the small plot cultivated intelligently and watered economically with a small pumping unit operating on a load factor schedule for a long period of time.

W. T. Waters, Advertising Manager, Georgia Railway & Power Co., (Atlanta) Creates New Type of Public Service Corporation Advertising.

A rather unique, interest creating method of frankly discussing the affairs of a public service corporation has been originated by Mr. W. T. Waters, advertising manager of the Georgia Railway & Power Co., of Atlanta. A general idea of the scheme and the way it is being worked out is given in the accompanying illustration of six typical advertisements recently used.

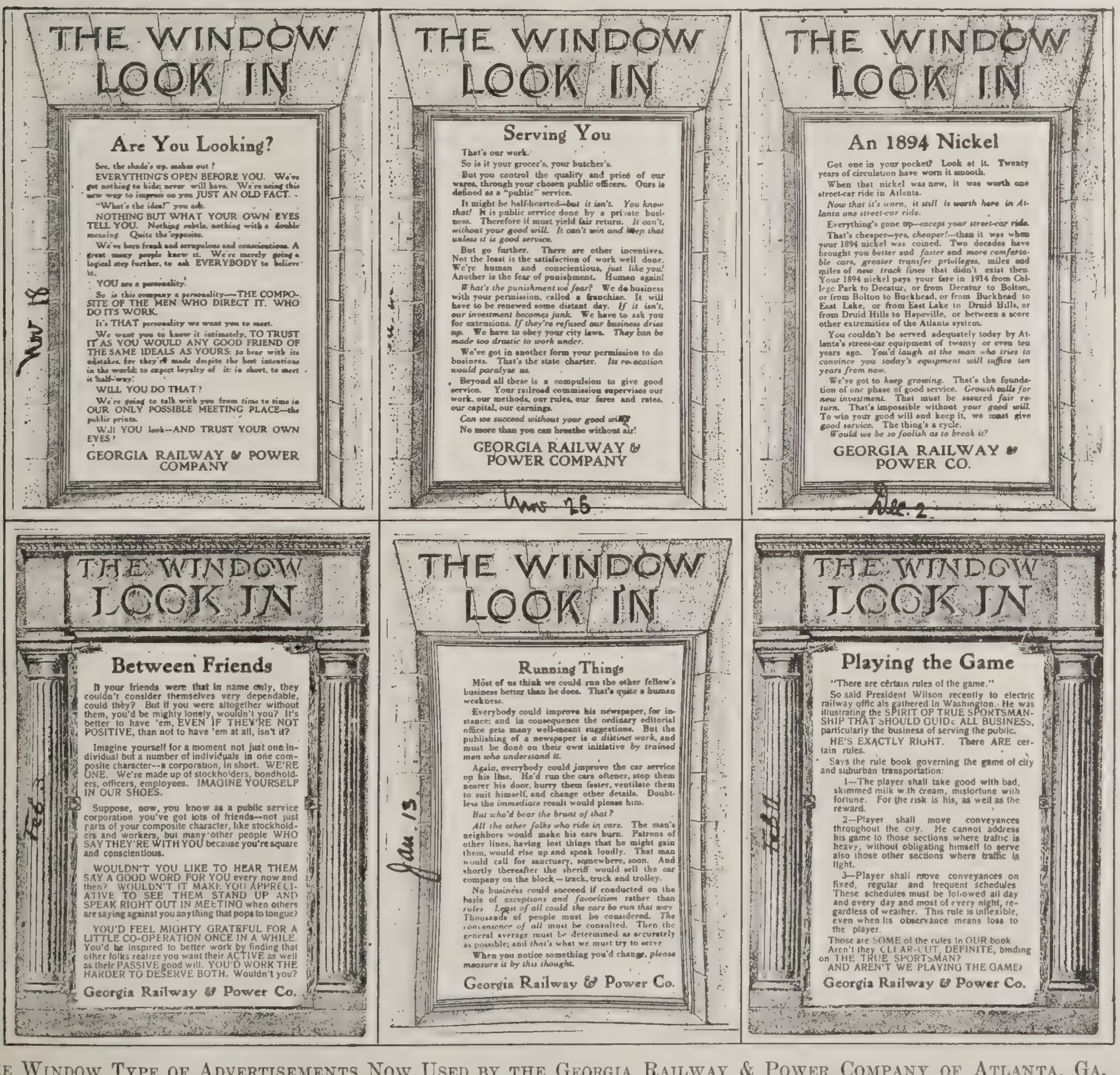
The window idea came to Mr. Waters through the following utterance by Ivy L. Lee, executive assistant of the Pennsylvania Railroad. "What the public wants is a window through which it can look into the affairs of public service corporations and so long as this vision is denied the public will be very suspicious as to what is going on in the windowless houses." "The Window" as it is being used by the Georgia Railway & Power Co. has as its definite purposes, the creation of public interest through its style and the subjects it presents; the winning of confidence through

sincerity and the cementing of its good will by good logic. In one sense, "The Window" is the company editorial; in another it is an expression of the company's personality; in another it is the brick-on-brick building of a barrier of unintelligent criticism, unsympathetic opinion and malicious attack. In the last sense, it seems to attain its greatest importance for its foundation is on the rock solid principle that the cumulative effect of little things is not to be torn down in a day by any man or any theory.

The Georgia Railway & Power Co. has cherished a full measure of good will as accorded by the American public to public service companies and "The Window" has therefore been raised before the eyes of a public not hostile openly, not thoroughly distrustful, and not antagonistic to the point of aggression so that the purposes of the window are as possible as they are definite. Thus far considerable favorable comment has been made in the editorial columns of dailies in other cities, for the movement has a strong appeal to the serious minded individual.

"The Window" series of advertisements appear on the average of once each week in each of the three Atlanta dailies and in a local labor journal. The series is to run indefinitely with no plans for same prearranged, the selection of topics being made from matters before the public at the time of publication. The first advertisement or the opening of the window appeared November 19th under the caption "Are You Looking." This ad is shown in the accompanying illustration. The caption of the second on November 25, was "Serving You" a declaration of the vital connection between good service and good will. The captions of some of the remaining ads and dates to February 15 are as follows:

December 2, 1914—An 1894 Nickel.
December 9, 1914—Baiting Corporations.
December 16, 1914—Pleasing Everybody.
December 23, 1914—When the Cars Stop.
December 30, 1914—Our Business, Too.
January 6, 1915—Your Bill Higher?
January 13, 1915—Running Things.
January 20, 1915—The Point of Contact.
January 28, 1915—One Nickel's Worth.
February 3, 1915—Between Friends.
February 10, 1915—Playing the Game.
February 11, 1915—That Game Again.
February 12, 1915—More Rules.
February 15, 1915—Fair Play.



THE WINDOW TYPE OF ADVERTISEMENTS NOW USED BY THE GEORGIA RAILWAY & POWER COMPANY OF ATLANTA, GA.

Besides this general publicity work the Georgia Railway and Power Company is carrying on a "Safety First" campaign. The company is endeavoring to prevent accidents among its patrons and employes in three ways. First, it buys the best material the market affords for tracks, rolling stock and station equipment. Second, it trains its employes to observe intelligently and with loyalty a system of rules evolved from experience. And third, it endeavors to educate the public to the necessity of being careful.

Recently the company tacked up on alternate window-posts in each of its cars, "Safety First" cards that ask the public to help the company maintain its record of carefulness. These cards admonish their readers not to let children play on or near car tracks; to keep calm if the controller flashes, as there is no danger; never to get on or off a moving car; never to walk around the rear end of a car. "Don't gamble with fate. Play safe. We are striving to prevent accidents. Lend us your aid," say the cards. In further endeavor to educate the public, the company is making it a point to inform newspapers just how accidents occur, so their accounts of accidents worthy a place in the news may contain authoritative detail. For instance, if a person is hurt while trying to board a moving car, the news account of it contains no lesson for the readers if they are told merely that the person was hurt by a car.

Some two dozen pulmotors have been purchased recently and installed by the company along its lines in North Georgia. The majority are in Atlanta, at points convenient of access in case of emergency. Two are in local hospitals and others in company stations. These represent the company's work to minimize the effect of all accidents. Another phase of this work is the rule that all car-men must summon an ambulance when anyone is hurt and must see the injured person started toward the hospital before they themselves proceed.

Automatic life-guards have been installed on all the cars of the company. These and the cars themselves are inspected regularly. The motorman makes written report on the condition of his car each night but whether he reports it in good condition or not, it is inspected. Cars are cleaned and disinfected regularly, to keep them from becoming disease carriers. Tracks and station equipment are inspected at stated intervals and are kept in as perfect condition as possible.

Applicants for positions in the company's transportation department are subjected to a rigid physical examination by the company's physician, and any defect of importance disqualifies the applicant immediately. Thereafter the physical condition of the employes is under the company's eye through the physician attending them in illness, and any impairment of their efficiency is noted at once. Accepted applicants are trained carefully and must qualify for work before cars are entrusted to their care. The rules of the company are printed. Each employe of the transportation department receipts for a copy when he is assigned to work, and he must have this copy with him at all times when he is on duty. A rigid system of discipline for enforcement of the rules is controlled by the merit and demerit plan, with suspension and discharge for penalties. Monthly meetings attended by all employes of the transportation department are addressed by officers of the company on topics pertaining to safety work.

There are only three or four railroad grade crossings in all the system of the Georgia Railway and Power Company. At each of these the rules require a full stop, and the conductor going ahead to signal the car on if the way is clear. At crossings on important highways not by underpass or overpass, the company has installed "Stop, Look and Listen" signs, and requires a full stop before continuance of headway. Full stops are required at every point, too, where the company's own tracks cross each other at grade. Automatic electric signals have been installed at various points on such single track lines as remain in the system.

The company plans the use of moving picture slides in furtherance of its educational campaign among the public at large. These slides will illustrate, by photographs taken in Atlanta, typical accidents liable to occur, and will warn readers against them. They will be displayed here and there at local theaters intermittently.

Activities of a German Electrical Company.

The Allgemeine Elektrizitas-Gesellschaft (General Electric Co.), at Berlin, which has a selling office in Nuremberg, is one of the most important manufacturing concerns in Germany, and ordinarily has an extensive foreign business. Its annual report, according to Consul Chas. S. Winans, for the year ending June 30, 1914, which has just been published, states that, in spite of political and economic tension in 1913-14, the sales and the orders of the company were larger than in the preceding business year, and would, if the war had not prevented their completion, have produced an equal, if not greater, profit. Notwithstanding this, the board of directors have been able to declare a dividend of 10 per cent as against 14 per cent in 1913.

The report touches upon the different branches of this gigantic concern, which are all naturally more or less affected by the war. At the close of the business year (June 30, 1914) the number of employes was 66,100 (68,700 in 1913); the later mobilization took 13,000 of these away. The company produced during the past business year 123,162 machines and transformers (132,452 in 1913), with an efficiency of 1,840,000 kilowatts (1,970,000 kilowatts in 1913. The small-motor factory produced about 2,000 machines more than in the preceding year. The turbine factory built machines with a total efficiency of 584,000 kilowatts (559,900 kilowatts in 1913). Turbo-dynamos were made with a power of 22,500, kilowatts.

A few figures, taken from this annual report, are here given in rough amounts at the rate of exchange established by the Government before the war. The gross profits amount to $5,390,000 ($8,044,000 in 1913); business expenses, $350,000 ($280,000 in 1913); taxes, $504,500 ($350,700 in 1913). The net profits reached $4,495,000 ($6,878,000 in 1913). The dividends call for $3,689,000 ($5,165,000 in 1913), and the sum of $238,000 is again turned into the aid fund. The balance shows a bank account of $26,560,000. Of this sum, $8,294,000 belongs to the affiliated rapid transit corporation, the A. E. G. Schnellbahn A. G., leaving for the concern proper $18,311,000 ($18,464,000). This sum is practically the same a sthat of the previous year, while the obligations of all debtors are a little lower, $46,843,000 ($47,062,000 in 1913). Securities amount to $13,466,000 (a considerable increase over 1913), with $10,212,000 representing chiefly shares, stocks, and bonds of German industrial incorporations, electrical works, and electric railroads..

A Timely Show Window Display.

An account of the formal opening of transcontintinental telephone service on January 25, when Dr. Alexander Graham Bell talked from New York to San Francisco, is found elsewhere in this issue. Newspapers throughout the country carried front page stories on this history making feat in telephone engineering and a general interest in the accomplishment was created.

A TIMELY WINDOW DISPLAY SHOWN THE MORNING AFTER OPENING THE NEW YORK SAN FRANCISCO TELEPHONE LINE.

The way in which an electrical store in New York City took advantage of this opportunity to call attention to the line of telephones handled, is shown in the accompanying illustration of its window dsplay. This window was arranged and the display on view as shown at 8 o'clock on the morning following the opening of the transcontinental service which was on Monday between 4 and 5 o'clock in the afternoon.

This is an excellent example of how national and local events can be turned to commercial advantage in a very effective way by the electrical dealer who is alive to modern methods of merchandising.

The Georgia Railroad Commission Rules on Street Car Seating Capacity.

The Georgia Railroad Commisssion in its decision rendered on the petition of the Georgia Railway and Power Company of Atlanta, Ga., to curtail service on certain city lines, while ruling against such curtailments on seven out of 14 lines, gave an interesting and common sense opinion on the matter of seating capacity of cars. The opinion in part is as follows:

"In our opinion it is the duty of the common carrier to provide seats, that is, reasonable accommodations, in its cars for such patrons as desire them, in so far as they can reasonably anticipate and measure the volume of traffic which will offer. Experience shows that there is, with fair regularity, an estimable volume of traffic during certain hours of the day. This should be provided for. But this does not mean that if an average of forty passengers customarily board a given schedule car on a certain route upon which is operated a forty-seat car, the car is then loaded to its reasonable capacity, and that when forty-one passengers begin to ride additional facilities must be provided.

"Careful observation has shown that an appreciable percentage of regular street car patrons prefer riding on the platforms to occupying seats inside the cars. These are styled "voluntary standees." Again, it must be borne in mind that city street car transportation is generally for comparatively short distances. A given route we will say is 5 miles long; cars are operated regularly the entire distance of the route. At an ascertained peak point, where the load is always heaviest, a forty-seat car will customarily have on board, say, forty-eight passengers. This maximum was only reached one block back. At the next block forward the car begins to discharge its load, and within two or three blocks the load is again below the seating capacity, no one having stood for a longer distance than three or four blocks or for a longer time than five or ten minutes. This particular schedule may have been—and observation demonstrates this—the only one at all overloaded during the whole day. Conditions frequently arise in street car traffic when it is impossible to avoid overloading for short distances or for short periods of time.

"Taking into consideration such conditions some commissions have held that facilities are fairly reasonable where the peak point loads do not exceed 30 per cent of the seating capacity offered for a continuous period of thirty or forty minutes. In our opinion, an allowance of 30 per cent over the seating capacity for standees, whether voluntary or involuntary, is too large. We are rather inclined to allow only 20 per cent on this account, to be extended not longer than thirty minutes with schedules operated on not exceeding ten-minute headway. It would not be reasonable to apply this rule to only one day's travel, or even a week's. The congestion should extend over such a reasonable period as would show that it is regular and not spasmodic; that it is permanent in nature and not due to temporary conditions. It would be unreasonable to require a carrier to operate sufficient cars to provide a seat for every passenger on every schedule or every day of every year and for every distance. Moreover, it is impossible even if the public would render the absolutely necessary co-operation in distributing the loads as between the cars offering.

"We have deemed it advisable to submit the foregoing general observations in order that the public may be reminded that the carrier is only required by law to supply reasonably adequate and comfortable facilities. It is the province of the commission to compel this reasonably adequate and efficient service. If at any time or upon any route there are shown to be facilities and service in excess of the reasonable needs of the public, it is just as much our duty to allow a reasonable reduction of this excess as to order more cars when service is shown to be inadequate."

Tungsten Ores in 1914.

The production of tungsten ores in the United States during 1914 is estimated as equivalent to about 990 short tons carrying 60 per cent of tungsten trioxide according to preliminary figures collected by Frank L. Hess, of the United States Geological Survey, which are thought to be accurate within 5 per cent. This output is the smallest since 1908, when only 761 tons was produced. In 1913 the production was 1,537 tons, of which 953 tons was ferberite from the Boulder field in Colorado, a quantity almost equal to that of the whole country in 1914, but the production of the Boulder field in 1914 was only 466 tons.

Prices ranged from $6.50 to $9 a "unit" (that is, so much a short ton for each per cent of tungsten trioxide), depending on the quality and quantity of the ore and urgency of the buyers' and sellers' needs.

The Small Lighting Plant---How to Sell it from Standpoint of Contractor & Dealer

BY A. N. BENTLEY, STORAGE BATTERY ENGINEER.

In the neighborhood of some cities, on the outskirts of many good sized country towns, and on farms, even where a central station company is operating, there are country homes still waiting for electric service. For these cases the small lighting plant is the solution of this situation and the means of introducing the advantages of electricity in the country. The lighting plant suited for these cases may consist of a small generator, engine and regulator with the lights connected directly to the generator but in most cases the requirements are best met when a set of storage batteries is used, current for lights being taken from the batteries charged by the engine driven generator. The sale of this apparatus is an interesting and profitable proposition for the average contractor and dealer and his success in this field depends largely on his ability to select the proper equipment for the probable users. In what follows therefore, a few suggestions are presented that will help the dealer in the sale of these small lighting plants.

Most articles on salesmanship begin by telling how to find the prospective purchaser and then go on to tell how to create in his mind a desire to possess the particular article which the salesman has to sell. In the small electric lighting plant field, there is no difficulty in finding the prospective purchaser, nor is it necessary to create in his mind a desire for possession. Practically every man whose home is beyond the reach of central station service and who could afford central station service if he could get it, is a prospective purchaser. There is no necessity for creating in his mind a desire for possession, as the desire is already there. The difficulty is to convince such a man that a small, individual plant can give good service at no great cost, and to induce him to make the investment necessary to install such a plant.

Starting with the assumption that the "prospect" has already been located and that he has the desire for possession, the first step in the sale of a plant is to get enough information about the purchaser's requirements to gain a clear and comprehensive understanding of exactly what he wishes to accomplish. You can not go ahead until you know what you are trying to do. This statement may seem trite, but it is right here that most salesmen fall down.

Getting this information is one of the hardest parts of the entire job and not one case in ten can be satisfactorily handled by correspondence. A customer may write in for a price on a plant to carry 75—32 c. p. lamps. He may have figured out that he could find places around his house and barns for a total of 75 outlets. He may not have gone that far. A few of these outlets might take 32 c. p. lamps but the majority of them, if equipped with 16 c. p. lamps, would probably give ample illumination and 8 c. p. lamps in many of them would be plenty large enough. The chances are that your customer's estimate of 75—32 c. p. lamps is simply a wild guess. In any event, he says nothing about how many of these 75 lamps will be actually in use at any one time, nor does he give you any other information.

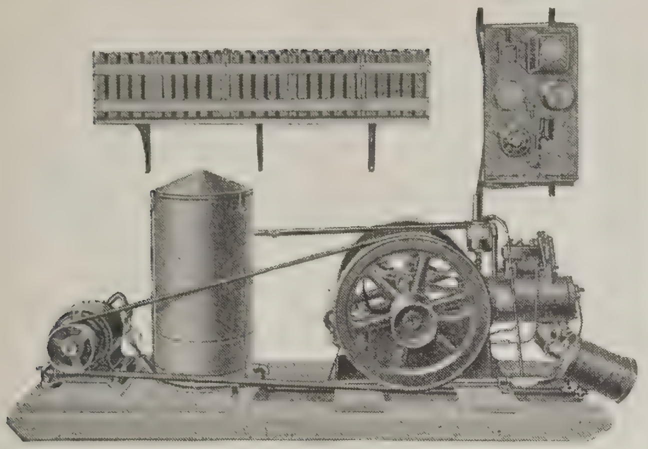
The only sure method is to go and see him at the first opportunity. Explain to him that he should determine the number and candle power of the lamps with the same thought which he would give to the subject if he lived in the city and had to pay some lighting company a flat rate of so much per month for each lamp connected, and so many cents per lamp per hour, additional, for each lamp in use, the charge being twice as much for a 16 c. p. and four times as much for a 32 c. p. as for an 8 c. p. lamp. Make him understand this clearly and the result is usually a materially decreased estimate of the number and candle power of lamps required.

The next step is to determine what portion of the total number of lamps will be in use from hour to hour during a period of 24 hours. This information should be given for an average winter day and, if fans are to be used, the same information should be given for an average summer day, including both lamps and fans. Here, again, there is trouble in obtaining definite information. The best plan is to go through the various buildings with your customer, advising and consulting with him regarding the number and location of the lamps and fans which will be in use from hour to hour in each room. Make notes of his decisions as you go along and, when you get through you will have a record something like the following:

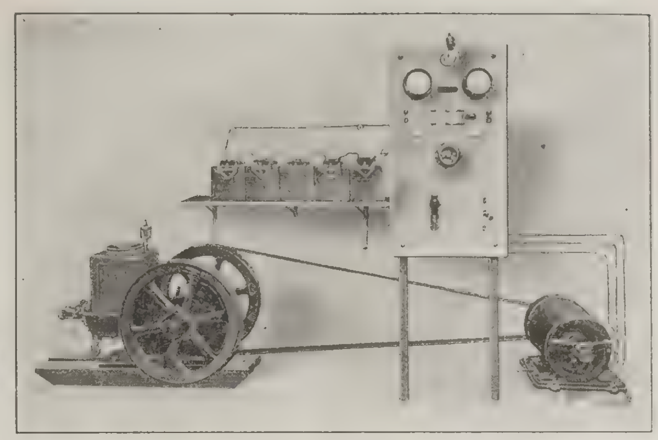
Front Porch:	1—10	watt	lamp	from	5:00	P. M. to	9:00	P.M.
Front Hall:	1—10	"	"	"	5:00	"	10:00	"
Living Room:	1—40	"	"	"	7:30	"	10:30	"
Living Room	2—20	"	"	"	5:00	"	10:00	"
Dining Room:	2—20	"	"	"	5:30	"	7:30	"
Pantry:	1—10	"	"	"	5:30	"	8:00	"
Kitchen:	2—20	"	"	"	5:00	"	8:00	"
Rear Porch:	1—10	"	"	"	5:00	"	8:00	"
Bed Room No. 1,	1—20	"	"	"	9:30	"	10:30	"
Bed Room No. 2,	1—20	"	"	"	5:00	"	7:00	"
" " " "	1—20	"	"	"	9:30	"	10:00	"

Having thus fixed the total number of lamps and their candle power, or wattage, and determined the average load from hour to hour, there are other points to consider before making your recommendations. Make a ground plan of the property, giving the distances between the various buildings and the number of lamps to be installed in each building; find out if your customer already has an engine and, if so, the horse-power rating, how much load it has to carry, how many hours per day it is in regular operation and between what hours. If your customer has no engine in regular operation, find out during what hours it would be most convenient for him to run an engine, if he buys one.

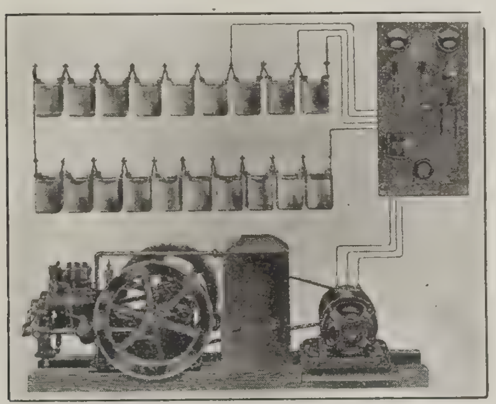
This completes the information necessary to make up your figures. In securing it, no opportunity should be neglected to impress on the customer your reasons for asking the questions and the necessity for accurate answers. Get him to ask for your advice and do not hesitate to give it. Up to this point, you have not been acting in the capacity of a salesman but, rather, in that of a consulting engineer and make your customer see this. Make him understand that you are trying to determine exactly what equipment



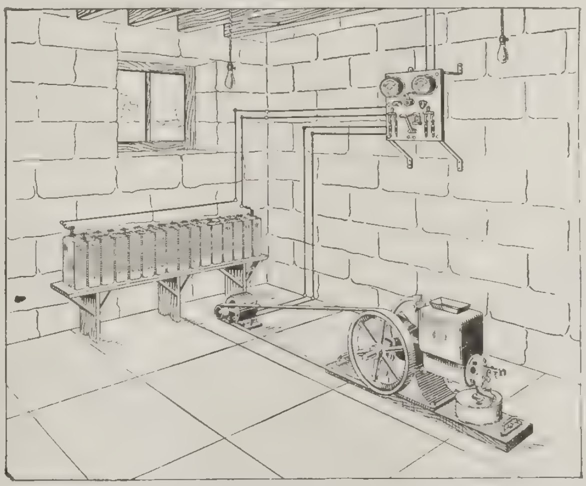
The Rumely Special lighting plant made in sizes of 75, 150, 300, 500 and 1200 lights of 8 candle power. Plants designed for 30, 60 and 100 volt operation and suited for lighting, small power loads and moving picture operation. Made by M. Rumely Co., La Porte, Ind.



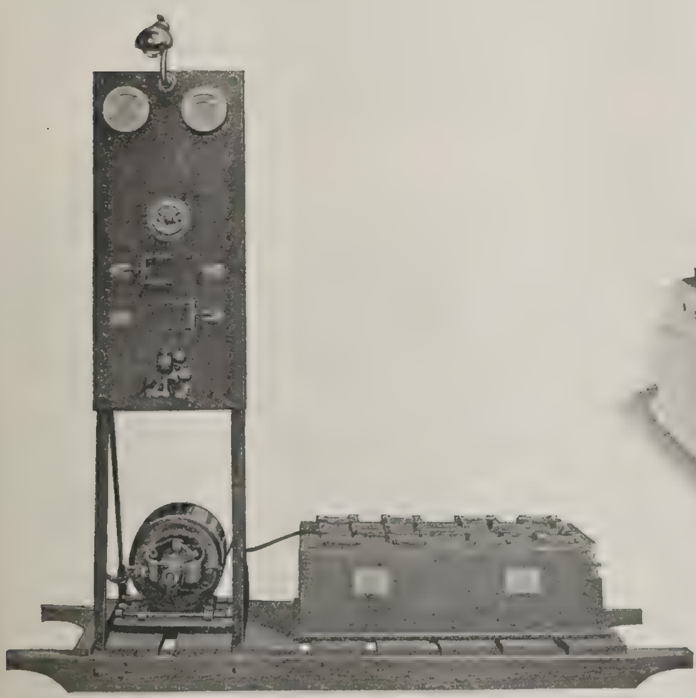
Complete lighting and power plant known as type 2-A to 4-E: sizes 1.0, 1.5, 2.0, 3.0, and 5.0 Kw. for from 70 to 415—c. p. lamps from combined generator and battery on 4 hour basis. Maker, Main Electric Manufacturing Co., 215-221 South Beatty St., Pittsburgh, Pa.



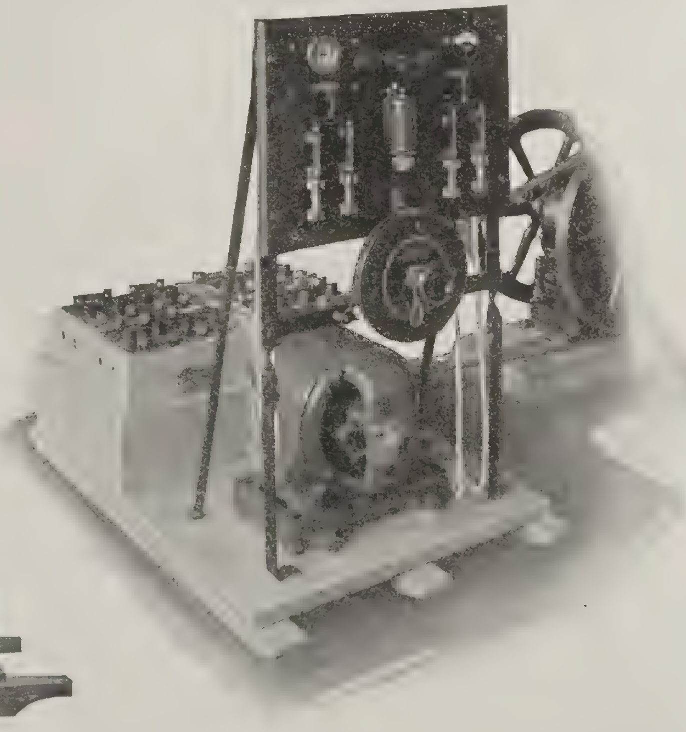
The Globe 30 volt lighting plant made in sizes for operation of 20 to 130 — 20 watt lamps. Other plants made for 60, 110 and 32 volt operation. Builders, Globe Electric Co., Milwaukee, Wis.



A 30 volt lighting set with battery of 4 to 36 — 16 c. p. lights, capacity and generator 8 to 120 — 16 c. p. lights capacity. Made by American Battery Co., 1132-34 Fulton St., Chicago, Ill.



A 32 volt lighting plant known as type A Capacity of battery 5.5 to 20 amperes for 8 hours. Capacity of generator 3/4 to 1.0 Kw. Made by Ideal Lighting Co., 1507-13 Rockingham Road, Davenport, Iowa.



The Hyray-Exide lighting plant handled by the Western Electric Company, using batteries made by Electric Storage Battery Co. of Philadelphia, Pa. Made in 12, 20 and 30 — 15 watt lamp sizes, with battery of capacity to carry this load for 8 hours.

will be required to give him the results he wants and, in so doing, you are acting in his interest. If you succeed in doing this, you have gone a long way toward making the actual sale, for you have gained his confidence and excited his interest.

With this information at hand, the next step is to lay out a plant which will best meet the requirements. Here again the salesman must be the engineer, and if he is not thoroughly familiar with the different types of plants on the market, the comparative merits of 32 volt and 110 volt systems and similar details, he is very apt to "kill" his sale at this point by allowing his customer to see that he is not quite sure of himself. The customer is almost invariably skeptical and wants to be "shown." His absolute confidence is the thing the salesman must get and hold. "He who hesitates is lost."

THE 32 VS. 100 VOLT SYSTEMS.

It might be appropriate, therefore, to consider a few of the engineering features of these plants before going further. The first thing to determine is whether to recommend the 32 volt or 110 volt system. Some manufacturers list plants of less than 32 volts, but they are not generally considered as embodying good engineering practice. The 110 volt system has been a standard for many years and the 32 volt system is now so well established that practically all current-consuming devices and small motors wound for this voltage are carried in stock by the manufacturers. We will confine our discussion, therefore, to the two standard systems.

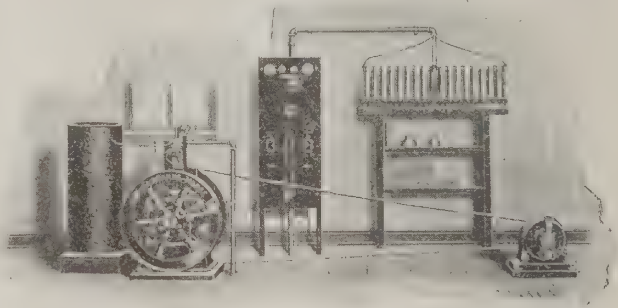
A great many salesmen appear to be incapable of thinking in terms of less than 110 volts, and have not yet "sold" themselves on the 32 volt system. As a general proposition, the salesman is justified in starting with the basic principle that a 32 volt is better than a 110 volt system and should try to sell the former in preference to the latter, for these reasons: It costs less to install. It is easier to operate. It is far more efficient. It is much less complicated. It can be used in connection with engines of inferior speed regulation. It carries less danger of shock, failure of installation and fire risk.

The question of transmission distances and load to be carried will determine whether or not the 32 volt system can be used, but the salesman should not immediately jump to the conclusion that the 110 volt system is necessary, simply because the distances are considerable and the load fairly heavy. The addition of one cell to the battery will make up for a drop of two volts in the line and the use of 30 volt, instead of 32 volt lamps, will make up for another two volts. Use your wire tables, figure out the size and weight of wire and the cost of battery, switchboard and dynamo for both systems and you will be surprised to find that, in spite of the heavier copper required for the 32 volt system, the latter will cost less in nine out of ten cases.

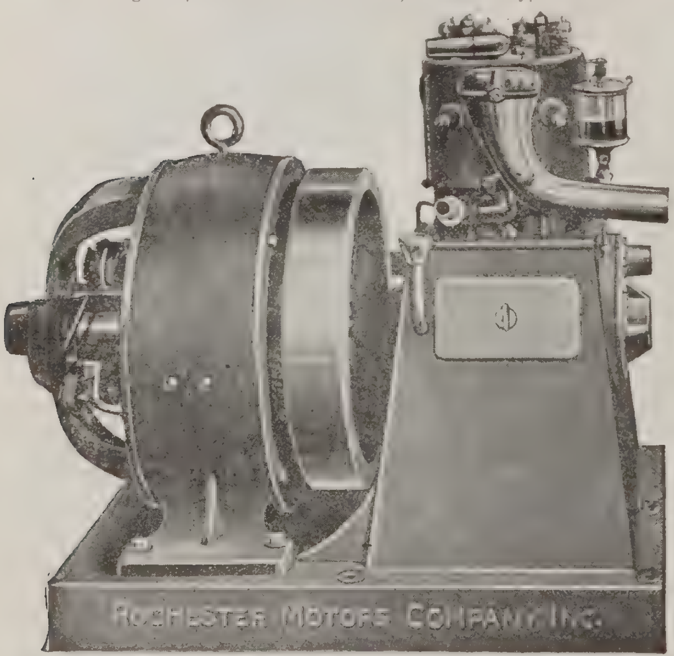
DETERMINING SIZE OF BATTERY.

Another important engineering detail which many salesmen fail to consider is that of properly determining the size of battery required. This can only be determined after a careful consideration of three factors: (1) The average daily load, expressed in ampere-hours. (2) The time avail-

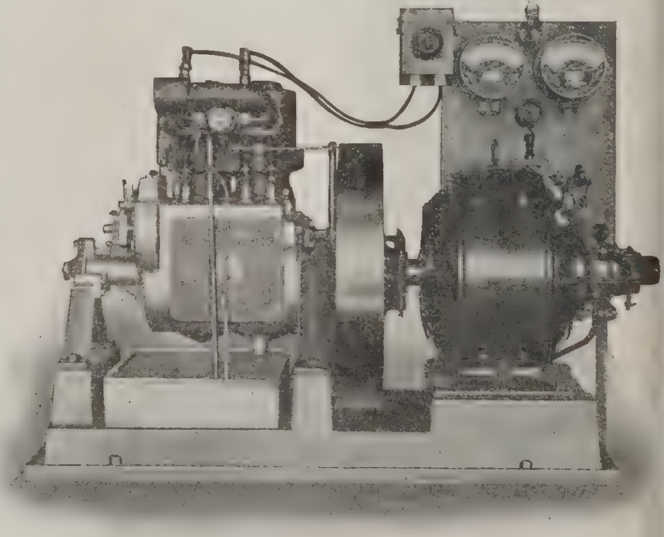
A 30 volt farm lighting plant with 60 ampere-hour battery and 1.0 Hp. engine. Equipment will operate 11 — 20 watt lamps for 8 hours from battery. Made by Barber Dwinnell Electric and Mfg. Co., 600 East 15th Street, Kansas City, Mo.



A 50—12 c. p., 30 volt lighting plant consisting of 2.0 Hp. oil engine and 900 watt compound wound generator. Capacity of battery for 13 lights on 4.75 hour basis. Made by Fairbanks-Morse and Co., 900 South Wabash Ave., Chicago, Ill.



Th Service gasoline electric set made by Rochester Motors Co., Inc., Rochester, N. Y. This set consists of a 2-cycle gasoline engine direct connected to a 2½ Kw. generator for 65 volt operation.



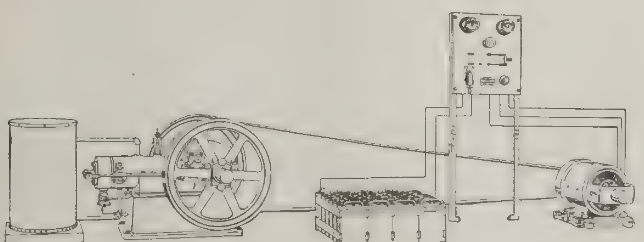
The Brush lighting set consisting of 10 Hp. engine direct connected to 4 Kw. generator for 60 or 115 volt operation. Made by Chas. A. Sterlinger Co., Detroit, Mich.

able for charging. (3) The time of day when the charging will be done.

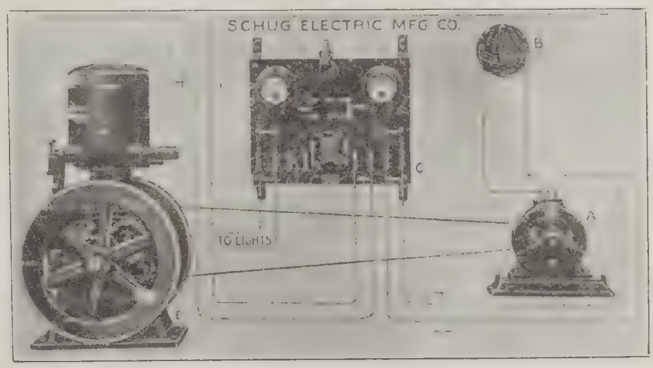
Assume a case where the customer already has an engine which he uses for pumping water. The average run of his engine is from 2 to 3 hours per day. The most efficient and economical lighting plant would be one which could be operated by the same engine and without running it any more than formerly, the pump being belted to one flywheel and the dynamo to the other, both being in operation at the same time. Take the average daily load as previously determined and reduce it to terms of ampere-hours. Subtract from the total, that portion which falls between the hours when the engine will be in operation. The remainder is the load to be carried by the battery between charges. This, however, does not fix the battery capacity. A fully discharged battery can not be given a full charge in less than 7 or 8 hours—unless the operator is more familiar with battery operation than the average owner of a small lighting plant. If the time available for charging is only four hours, a battery must be selected which will not be more than 50% discharged between charges. If the time available for charging is only two hours, the battery must be only 25% discharged between charges. In other words, the shorter the time of running the engine, the larger the battery, irrespective of the load to be carried.

At first glance, one might think that this method of figuring the size of battery required would run the cost of the plant too high, but the only alternative is to operate the engine more hours per day. The larger battery will make no material difference in the cost of the switchboard and very little, if any, in the cost of the dynamo. The question to be determined—and it should be thoroughly discussed and settled with the customer—is, therefore, which he prefers; an increased cost of fuel, oil, labor, wear-and-tear on the engine and little reserve in battery capacity, or a minimum cost of fuel, oil, labor, wear-and-tear on the engine and ample reserve in battery capacity so that, should necessity arise, he could run for 3 or 4 days without the engine or on some special occasion could turn on every lamp in the house without fear of a failure of current. An additional argument in favor of the larger battery is that it will last much longer than a smaller one, because it is not worked as hard and is not liable to injury through lack of charge.

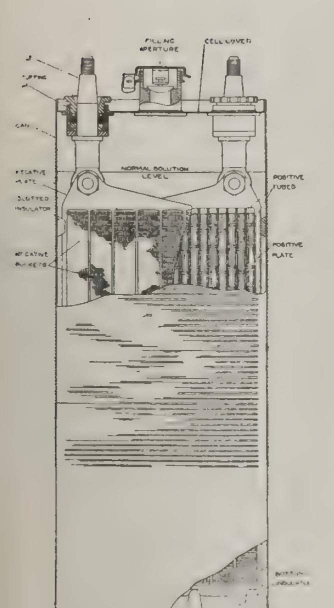
To return then, to the point where we digressed, to discuss these more or less technical matters, we have obtained from our customer the desired information and are now ready to lay out our plant. It is an excellent plan to do this with your customer looking on over your shoulder and



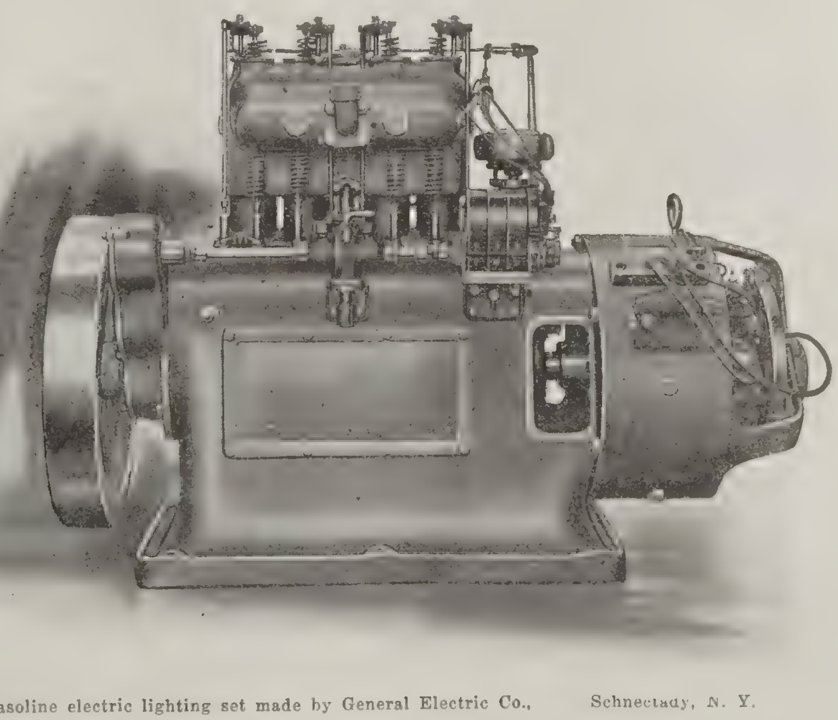
Edison 30-32 volt lighting plant. Battery capacity 24 — 20 watt lamps for 5 hours. Generator capacity 45 — 20 watt lamps. Made by Edison Storage Battery Co., 1098 Lakeside Ave., Orange, N. J.



A small lighting plant for the country home. Made by Shug Electric Mfg. Co., Detroit, Mich.



The Edison Storage Battery in Section. Made by Edison Storage Battery Company, Orange, N. J.



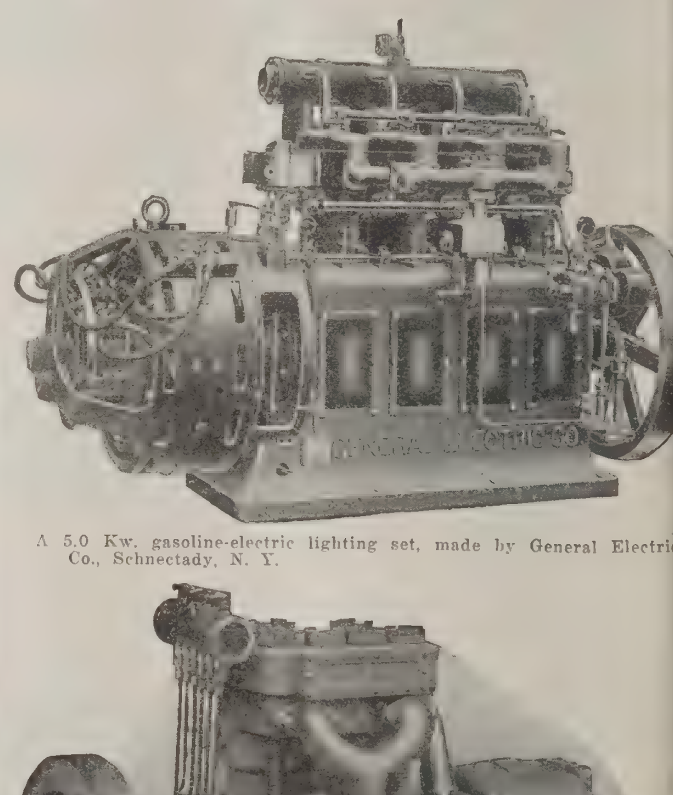
A 25 Kw. gasoline electric lighting set made by General Electric Co., Schenectady, N. Y.

to explain and discuss each point as you go along. Take the figures on the average daily load. Get a piece of cross-section paper out of your grip and lay out a load curve for 24 hours. Your customer may not know what it is when you get it finished, but it looks impressive. Cross-section that part of the load curve between the hours when the engine will be in operation. The balance of the curve represents the load to be carried by the storage battery. Explain these things as you go along. Fix the size of battery required with reference to the load to be carried and the time available for charging, and get the price of the battery from your price book. Determine the generator capacity by adding to the maximum load while the engine is running (as shown on the load curve), the additional load of the battery charging current. Get your dynamo and switchboard prices from the price book and add any extras, such as freight, cartage, installation, etc. The total is your selling price.

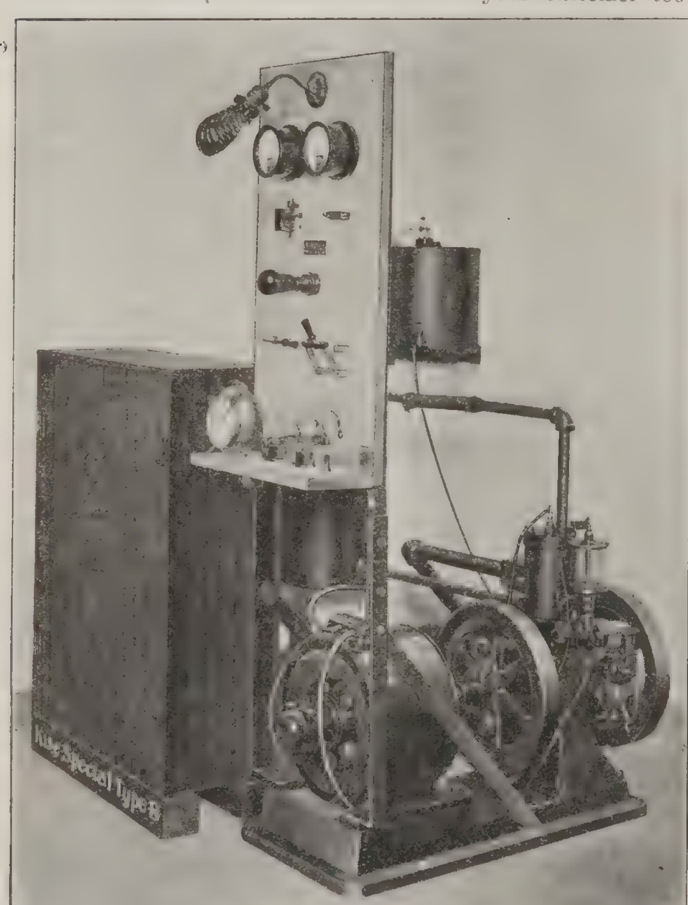
If you have followed the argument thus far, you will have observed two fundamental ideas, first, to gain the confidence of your customer and impress upon him your ability to handle the engineering features of the installation and, second, by consulting with him on each detail as you go along, to induce him to decide on exactly what he wants before you quote him any price on the complete plant. When you quote him that price, therefore, you are in a position to stick to it as the only way to change it is for the customer to go back on his first decision regarding the kind of plant he wants. Use your best efforts to induce him to pay the price on the theory that the best is always the cheapest.

It is usually unwise to leave with your customer too detailed a description of what you propose to furnish, or your notes on the requirements, such as the average load, time available for charging, etc. Your customer will probably ask for prices from your competitor and, if your competitor does not know how to lay out the plant properly, your customer will soon discover that fact and it will count in your favor. On the other hand, you must follow your customer up closely enough to prevent his placing his order with your competitor for what he thinks is the same plant as the one on which you quoted. There are a great many things which can be left out and still leave a plant which will work fairly well for a time. For example, your plant may have an ampere-hour meter on the switchboard and your competitor's may not. You may be figuring on glass covers and glass sand trays for the battery and your competitor may have omitted these items. Get your customer to obtain an itemized list of the material which your competitor proposes to furnish and then let him have yours.

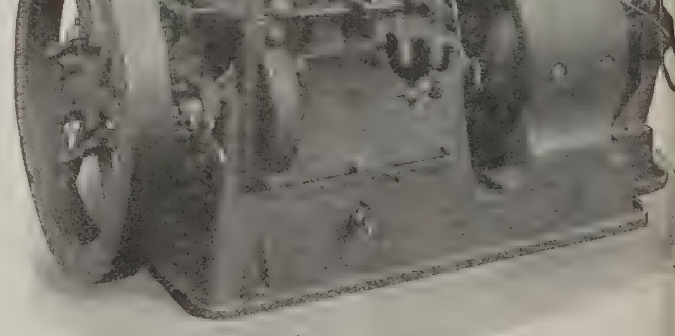
Without "knocking" your competitor's plant, you can then point out the features wherein your plant is superior and the order should be forthcoming.



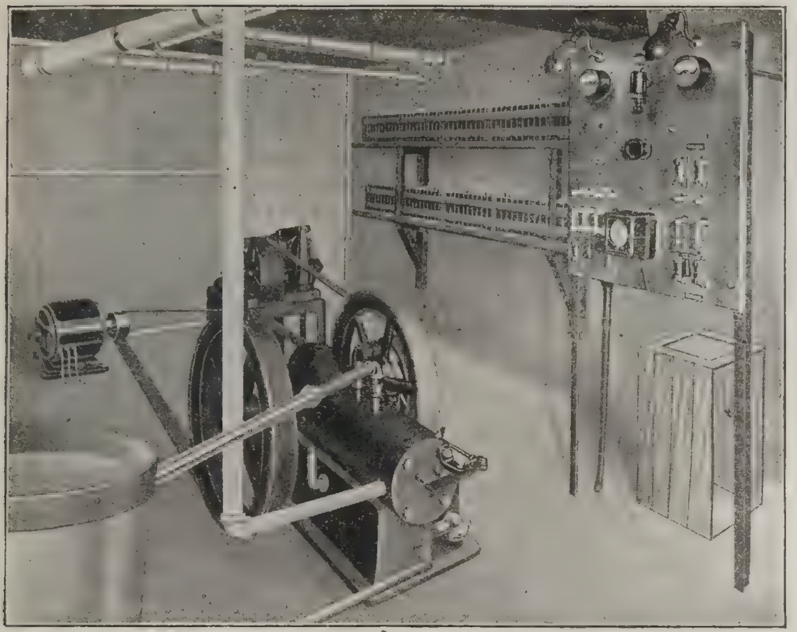
A 5.0 Kw. gasoline-electric lighting set, made by General Electric Co., Schnectady, N. Y.



A direct connected lighting plant made by Kise Electric Co., Peoria, Ill., in sizes for 50, 100 and 150 lights.

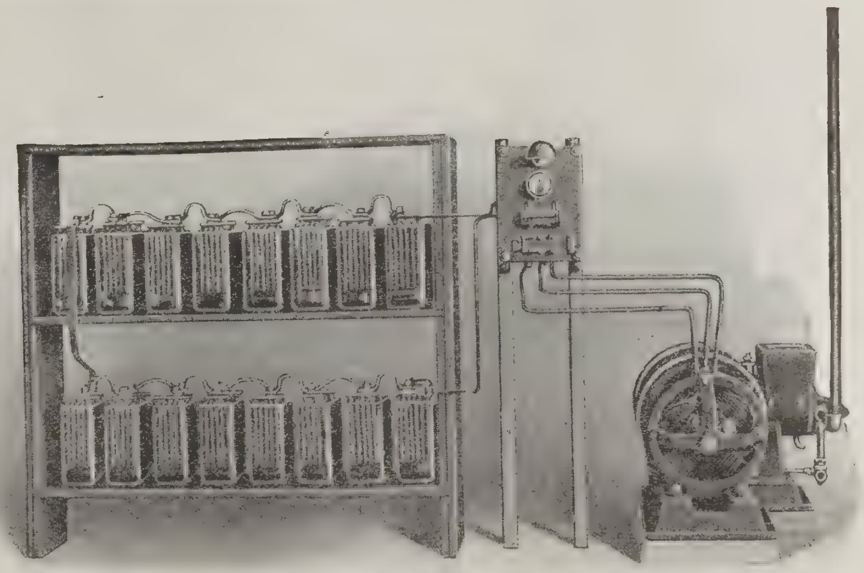


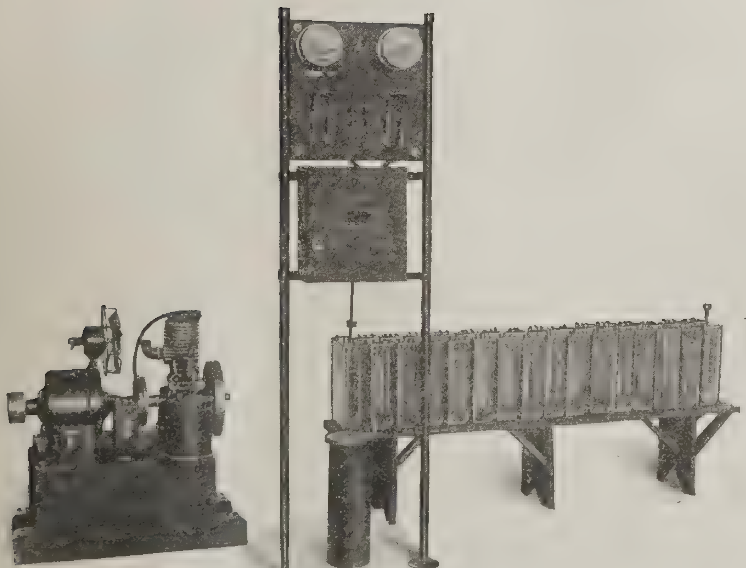
Direct Connected lighting unit of 100 — 16 c. p. tungsten lamps capacity. Generator wound for charging batteries at 60 volts and for 110 volts for operating lights direct. Generator driven by two cylinder engine with sensitive governor. Made by Carlisle and Finch Co., 229-231 East Clifton Ave., Cincinnati, Ohio



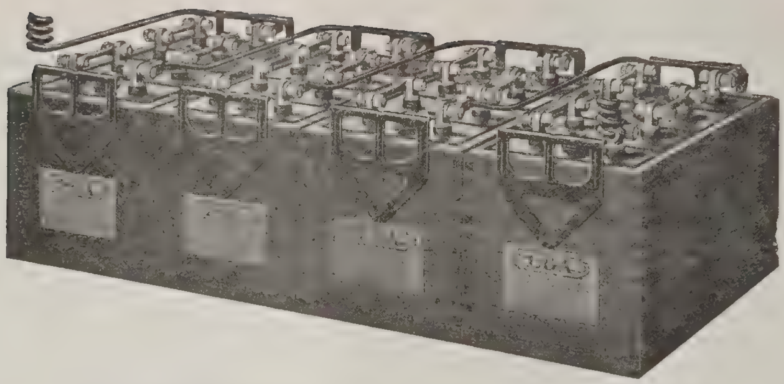
A combination pumping and Edison Lighting Plant, for 110 volt operation, 45 to 165 — 20 watt lamps. Made by Edison Storage Battery Co., Orange, N. J.

A 32 volt lighting plant of from 15 to 150 — 15 watt, 12 c. p. tungsten lamps, capacity on battery of 16 cells and 4 hour basis. Made by Carlisle and Finch Co., 229-231 East Clifton Ave., Cincinnati, Ohio.

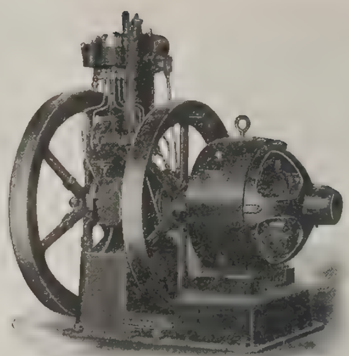




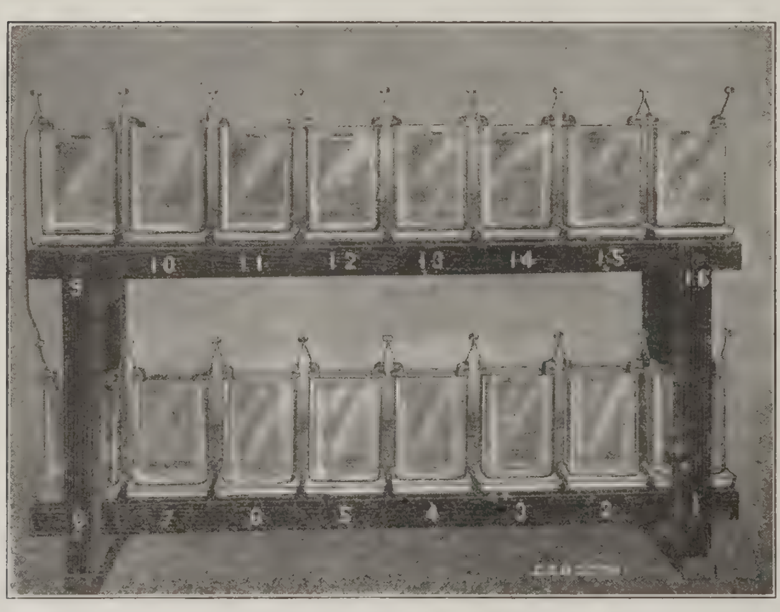
A battery lighting equipment known as Junior No. 1, consisting of 1½ Hp. engine direct connected to 1-3 Kw. generator and battery of 16 cell with capacity of 40 ampere-hours. Made by American Battery Co., 1132-34 Fulton Street, Chicago, Ill.



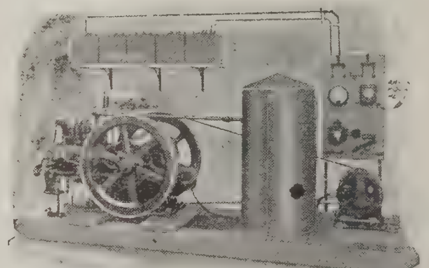
A 16 cell enclosed type of storage battery, made by Willard Storage Battery Co., Cleveland, Ohio.



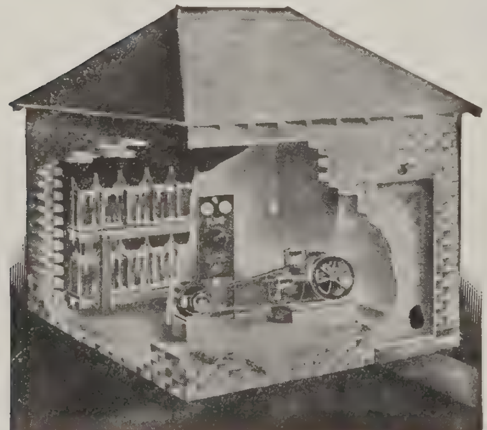
A direct connected oil engine and generator lighting unit for 32 volt operation. Unit is self-regulating and maintains constant voltage for any number of lamps up to capacity burned. Made by Fairbanks Morse and Co., Chicago, Ill.



A storage battery suitable for a small lighting set. Made by Electric Storage Battery Co., Philadelphia, Pa.



The Lauson Special lighting plant. The generator has a capacity of 750 watts at 30 volts for operating lamps direct. Battery capacity is 50 — 10 watt lamps for 3 hours. Made by The Warner Lamp Co., Davenport, Iowa.



Low voltage lighting plant, 15, 30 and 40 volts, in sizes from ½ to 3.0 Kw. Battery Capacity 14 to 35 amperes for 8 hours. Generator capacity 20 to 55 — c. p. lamps. Made by Hoosier Storage Battery Co., Evansville, Indiana.

OTHER MANUFACTURERS OF SMALL LIGHTING PLANTS ARE:

Gray Electric Company, Springfield, Ohio.

Incandescent Light and Stove Co., Oakley Station, Cincinnati, Ohio.

Dayton Electrical Mfg. Co., Dayton, Ohio.

New Britain Machine Co., New Britain, Conn.

Crocker-Wheeler Co., Ampere, N. J.

Mechanical Appliance Co., Milwaukee, Wis.

Apple Electric Co., Dayton, Ohio.

Inst. Lighter Co., Columbus, Ohio.

Moon Mfg. Co., Chicago, Ill.

National Meter Co., New York City.

Richardson Engineering and Mfg. Co., Hartford, Conn.

Silvey Electric Co., Dayton, Ohio.

Michigan Storage Battery Co., Detroit, Mich.

J. F. Ashbrook, 2639 Emmet St., Chicago, Ill.

Otto Gas Engine Works, Philadelphia, Pa.

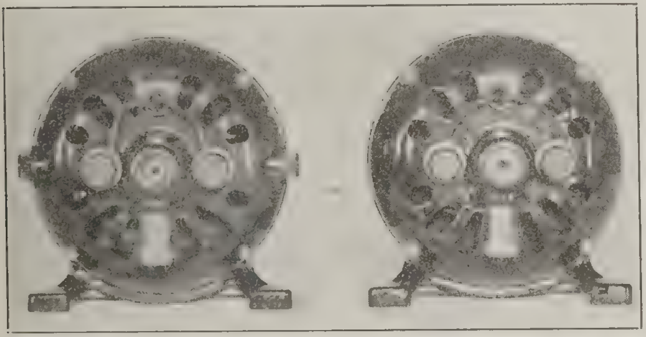
The Ampvo Storage Battery Co., 3031 Michigan Ave., Chicago, Ill.

New Apparatus and Appliances

New Types of Diehl Small Motors.

An entirely new line of fractional horsepower motors for use on direct and alternating current circuits has been designed and put on the market by the Diehl Manufacturing Company of Elizabeth, N. J. The whole line is built for interchangeability between similar D. C. and A. C. ratings which give the user great advantage of using one design of base, bracket and motor space without regard to the character of current to be used.

Mechanically these motors are as light and strong as possible and were designed from a viewpoint of service, attractive appearance and compactness. Motor feet do not project beyond the body lines, are drilled for attachment and are strong and substantial. Shafts are sufficiently strong to withstand loads far beyond the capacity of the motor. Oil return channels in bearings return excess oil to cups, obviate throwing or dripping of oil and supply a circulating system of lubrication. Ample ventilating space is provided although all moving parts are protected with a view to internal cleanliness with little care or maintainance.



DIEHL 1/25 HP. MOTORS—ALTERNATING CURRENT TYPE ON RIGHT AND DIRECT CURRENT ON LEFT, BOTH OF SAME SIZE.

To show the absolute interchangeability between frames bearing similar ratings for A. C. and D. C. the manufacturer claims that curved plotted from the performance of a direct current motor showing characteristics from no load to full load will be practically identical to curves plotted from the performance of alternating current motor under similar operating conditions, and visa versa. The two smaller frames of this new line are rated 1/50th and 1/25 horsepower respectively at 1725 revolutions per minute. These motors have die cast shells and covers. The larger sizes up to ¼ horsepower are furnished with cast iron frames and covers.

Locking Sockets and Receptacles.

An improved design of locking sockets and receptacles of both the key and keyless types has been produced by the General Electric Company. These sockets and receptacles afford positive protection to lamps in public or semipublic places, such as hotels, street cars, mills, factories, assemblage halls, theatres, school dormitories, etc., where losses of lamp bulbs oftentimes occur. They also prevent the theft of current. Lamps can only be inserted and removed by aid of the key, and the improved principle of the design also provides against breakage from tampering. When the key is removed, the screw shell of the socket swivels freely, thereby avoiding injury either to the lamp base or socket if a sudden attempt is made to twist and remove the lamp bulb without the key.

These sockets and receptacles constitute an ideal installation for residence lighting in connection with a system of burglar or emergency light controlled by master switches located in the bedrooms. Should the necessity suddenly

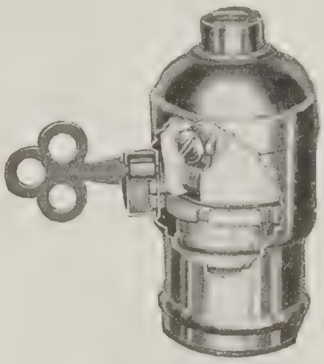
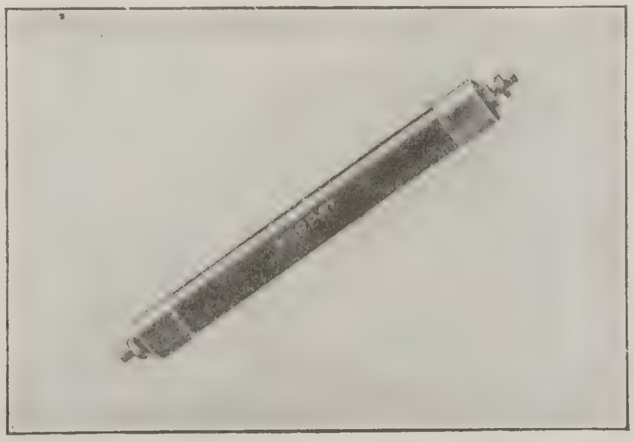


FIG. 1. VIEW SHOWING CONSTRUCTION OF THE LOCKING SOCKET.

arise, from the sound of an intruder in the house, unexpected illness or other cause, the occupant of any bedroom can turn a convenient switch and flood the entire house with light. Then if the lamps in the circuit are in locked sockets and receptacles, they can neither be turned off or unscrewed, and if otherwise protected so that the bulbs cannot readily be broken, they will remain lighted as long as the master switch is closed.

A New Resistance.

A new resistance known as "Koppat" is being placed on the market by The Railway and Industrial Engineering Co., of Greensburg, Pa. This is a vitreous composition material which can be made in various shapes and dimensions and of ohmic resistance to meet most commercial requirements. Its electrical and physical properties both combine to make it the best suited to meet the requirements for which wire wound resistance is now generally used. It conducts current uniformly throughout its entire mass, is



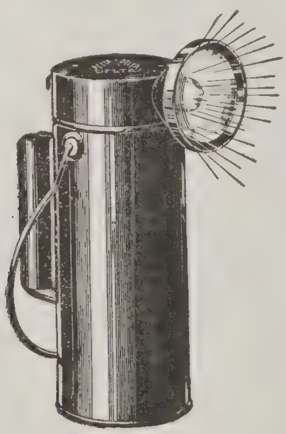
KOPPAT RESISTANCE UNIT.

strong mechanically, and has a low temperature coefficient of resistance. It will not oxidize nor is it subject to any chemical or other depreciation when exposed to any climatic or atmospheric condition.

The resistance was originally developed for use in connection with the Burke Horn Gap Lightning Arrester. This service called for a resistance that was weatherproof in every respect and one capable of withstanding extremely heavy current momentarily and the attending strains. Koppat has proved so satisfactory in connection with various classes of lightning arrester work that it is being placed on the market for other commercial needs, such as switchboard work, rheostat service, storage battery charging, and as permanent or limiting resistance to be used with arc headlights, signals, etc., and in the form of resistance units mounted on brackets for various services.

Delta Spotlight Reflector.

The accompanying illustration shows an electric hand lamp and lantern made by the Delta Electric Company of Marion, Indiana. This lamp is made up with a design of searchlight reflector and lamp such that a powerful light is given on small current consumption. It is claimed that

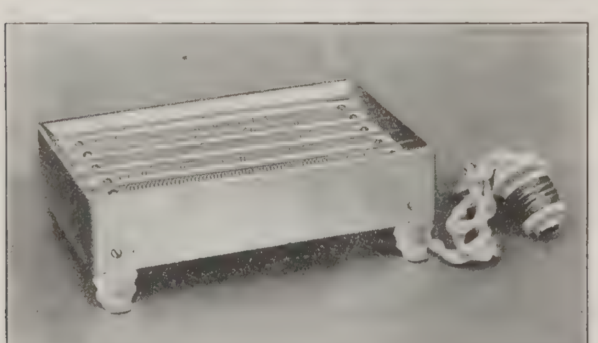


THE DELTA ELECTRIC LAMP.

the reflector throws the light a distance of 300 feet with an intensity sufficient to see objects clearly at night. The lamp is operated by a single dry cell and is arranged for convenience in carrying as a lantern and as a hand lamp, a bale and handle being provided as shown.

The P. J. Electric Toaster.

A design of electric toaster has been developed by the P. J. Electric Heating Co., 332 South La Salle St., Chicago, Ill., for which special claims are made. The heating element consumes 440 watts and is arranged so that it comes to a red heat quickly and makes uniform bread



THE P. J. LIGHTNING TOASTER.

toasting possible with little waste of energy. A surface 4 by 7 inches is provided so that two piece of bread can be toasted at a time. An approved silk-covered cord and plug is provided and the device finished in nickel, brushed brass or copper. Low first cost and economy in operation are the features said to interest dealers.

Electrical Construction News

This department is maintained for the benefit of contractors, dealers, manufacturers and consulting engineers.

ALABAMA.

BAY MINETTE. The firm of Sullivan, Long & Haggerty Company of Bessemer, Ala., has secured a contract to construct an electric light plant and waterworks system for this place. The electric light plant will have a 50 Kva. generator, belted type. Two miles of pole line will be constructed.

DAUPHIN ISLAND. The Tidewater Securities Corporation is Planning to install an electric light and power plant. J. M. Dewberry is president, at Mobile, Ala.

PIEDMONT. It is understood that day service is under consideration and the installation of additional equipment in the plant at Piedmont.

GEORGIA.

CORDELE. The city is planning to install an electric light plant. J. G. Jones is mayor.

CUTHBERT. The city pans to purchase a 125 Kw. generator and engine. A. E. Turner is superintendent.

QUITMAN. J. B. McCrary Company has secured contracts to install an electric light plant of two 250 Kva. generators, engines and boilers, switchboards and exciters, pumps, engines, and accessories, to be installed at Quitman.

HOPKINSVILLE. The city is to install a 75 Kw. generator and motor driven pump of 250 gallon per minute capacity.

TOCCOA. A water power site about 3½ miles east of Toccoa has been purchased by the city, and a municipal plant is proposed.

WAYCROSS. The Ware County Light & Power Company plans to make extensions to its distribution system. R. E. Krexler is assistant treasurer.

KENTUCKY.

HAZARD. The Hazard Light & Power Co. has been reorganized. The plant operated 1½ miles of transmission lines.

IRVINE. A franchise has been granted to J. W. Walker of Corbin, Ky., for an electric light and ice plant.

LOUISIANA.

BASTROP. The city has voted $16,000 in bonds to improve the electric light plant and waterworks system.

LINTON. The Linton Ice, Light & Water Company has been organized with a capital stock of $20,000. An electric Light plant and ice factory is planned.

NORTH AND SOUTH CAROLINA.

DUKE. The Erwin Cotton Mills Co., of West Durham, N. C., is making additions to its steam plant.

LAGRANGE. It is understood that the city proposes to install an electric lighting plant and is to issue $50,000.00 in bonds.

RALEIGH. The Yadkin River Power Co. has increased its capital stock from $4,000,000.00 to $5,000,000.00.

WALTERBORO, S. C. The city is to nstall an electric light plant to cost approximately $15,000. Plans are being prepared by H. F. Joudon Engineering Company, Savannah, Ga. The plant will be of 60 Kw. capacity.

TENNESSEE.

CLARKSVILLE. It is understood that an ornamental street lighting system will be installed at an early date.

CAMDEN. The electric light plant recently destroyed by fire will be rebuilt by J. S. Madrey & Son. Building proposals will be open about May 1st. The cost of contemplated equipment is about $5,000.

PARIS. The city plans to install an additional 500 horsepower unit and make other extensions estimated at $8,000.

SEVIERVILLE. The Sevierville Light & Power Co. has been incorporated by Stanley McMahan and others, and plans to construct a power plant and transmission line to cost approximately $6,000.

SHELBYVILLE. It is understood that the Tennessee River Power Company has purchased the Duck River Power Company's plant and will make improvements.

PERSONALS.

MR. EARL F. SCOTT, M. E., 702 Candler Bldg., Atlanta, Ga., has been appointed Georgia representative for the Terry Steam Turbine Co., of Hartford, Conn.

MR. H. R. SMITH, formerly industrial engineer with the United Electric Light & Power Co. of New York City, has been appointed sales engineer for the Westinghouse Electric and Mfg. Co., covering the Essex, Central and Southern divisions of the state of New Jersey.

MR. J. A. BENNAN, treasurer and general manager of the Thordarson Electric Mfg. Company since its incorporation, has recently severed his connections and incorporated the Jefferson Electric Mfg. Company, located 847-851 West Harrison Street, Chicago. The new company will manufacture a complete line of bell ringing, toy, sign lighting and welding transformers, battery switches, steel battery box outfits, make and break and jump spark ignition coils, and a line of high tension transformers for testing, laboratory and research work.

COLE, IVES AND DAVIDSON is a new firm of consulting engineers made up of William W. Cole, formerly of 43 Exchange Place, New York City, and Ives and Johnson, of 84 Williams street. The offices of the new organization are at 61 Broadway, New York, and especial attention will be given to investigations and reports for financial interests, inventories and valuations of public utility or industrial properties and design or management of power plants of all descriptions.

WALTER G. KIRKPATRICK, formerly special engineer in the executive department of the Alabama Power Co., Birmingham, Ala., has taken over the business of the firm of Kirkpatrick, Sulley, McCorkle and Baylis. A general consulting engineering work will be conducted with offices at 704 Farley Building.

MR. JOHN S. MABRY, manager of the Kimball House, Atlanta, Ga., is considering the installation of generating equipment for power and lighting service. The plans include the purchase of two 100 Kw. direct current, 3-wire generators direct connected to one 200 Hp. four valve automatic engine and one 200 Hp. plain slide valve engine. A 200 Hp. boiler will also be required and mechanical stokers, together with switchboard and instruments and auxiliary equipment.

Mr. Leo C. Cox is chief engineer of the Kimball House and has been in charge of the mechanical and electrical work for the past two years. He will plan and have charge of the contemplated equipment.

Industrial Items.

The NATIONAL METAL MOLDING Company, Pittsburgh, Pa., reports that the contract for "rigid conduit" in the new Equitable Building of New York City calls for 220 miles or 983 tons of "Sheraduct."

The TRUMBULL ELECTRIC MFG. Co., Plainville, Conn., has just placed on the market a new push switch which has been under development for the past three years. A feature of the switch as advertised by the manufacturer is its remarkable electrical strength, it being claimed that the switch has stood up under an overload 50 per cent greater than any switch on the market. It is made up of few parts and the parts where strength is needed given particular attention.

MATHIAS KLEIN and SONS, Chicago, Ill., announce that beginning January 1st the company is to be represented in the United States and Canada by Messrs. Surpless Drum & Co. of New York and Chicago. This action has been taken with a view to a more general representation in a broader market.

The ELECTRIC CONTROLLER & MANUFACTURING COMPANY, Cleveland, Ohio, announces that the O. H. Davidson Equipment Company, Ideal Building, Denver Colorado, will act as its representative in Colorado, Utah, Montana, Wyoming, South Dakota, New Mexico and Arizona.

The GENERAL INSULATOR COMPANY, 1008-14 Atlantic Ave., Brooklyn, N. Y., reports that while the company's business has been been affected by general industrial conditions in the same way as many others, nevertheless the volume of business for 1914 was little below that of the previous year. Based upon orders now being received, the outlook for the coming year seems bright. The company manufactures hard rubber substitutes and electrical insulating specialties.

The TITAN STORAGE BATTERY COMPANY of Newark, N. J., has changed its name to General Lead Batteries Co. This change has seemed advisable on account of the existence of a battery jar marketed under the name "Titan." Any possible confusion will thus be avoided through the change.

THE TURNER ELECTRIC SUPPLY CO., Birmingham, Ala., has made special arrangements to handle a large fan business this season and has a large stock of Emerson, Peerless and Menominee designs, which seem to meet the popular demand in the South. Mr. Fred R. Schening and Mr. J. W. Egee have been added to the travelng staff. Mr. Schening has the Georgia territory and Mr. Egee southern Alabama.

THE DESPATCH MANUFACTURING CO., of No. 104 North 2nd St., Minneapolis, Minn., is desirous of arranging with representatives and selling agents to handle its portable electric room heaters attachable to electric light sockets, its electric ovens and other electrically heated appliances.

THE STOW MANUFACTURING CO., Binghamton, N. Y., has recently issued Catalogue No. 54 describing new portable electrically driven tools now being offered to the trade. Bulletin No. 400 has also been issued illustrating other tools made by this company such as twist drills, small grinders, buffers, suspension drills, etc. This company is said to be the oldest portable tool manufacturer in America and their tools for bench and floor use are popular on account of practical design and reliability.

THE SIMPLEX WIRE & CABLE COMPANY, of Boston, has been awarded the contract to manufacture and lay about one mile of three conductor, cambic insulated, 15,000 volt submarine cable for the Rockingham County Light & Power Company, of Portsmouth, New Hampshire. The cable is to be laid across Great Bay, above Portsmouth, early in the spring and will form a part of the transmission line from the central station at Portsmouth, through the towns of Newington, Durham and Madbury to Dover where current is supplied from the Dover, Somersworth and Rochester Street Railway. At Durham a branch line supplies light and power to the New Hampshire College. Each conductor is to be No. 4 B. & S. stranded copper and will have varnished cambric insulation 7/32 inch thick. A jacket of varnished cambric 6/32 inch thick will be applied over the three insulated conductors after they are twisted together. The cable is to be protected by a lead sheath ⅛ inch thick and an armor of No. 6 B. W. G. galvanized steel wire, and will weigh about twelve pounds per foot. It will be sent from Boston to Portsmouth on a lighter, the gross shipping weight being about sixty-five thousand pounds. The T. A. Scott Company, of Boston, marine contractors and wreckers, will supply the lighter and apparatus to be used by the Simplex Wire & Cable Company on this work.

OBITUARY.

MR. H. WARD LEONARD, inventor and founder of the Ward-Leonard Company of Bronxville, New York, makers of electrical controller devices, was stricken with apoplexy February 18th, on his way to an A. I. E. E. dinner in New York City and died within an hour. Mr. Leonard was fifty-four years old and some ten years ago retired from active work, acting as the company's consulting engineer since that time. He was a well known electrical engineer, a founder of the American Institute of Electrical Engineers and one of its board of managers.

Alphabetical Index to Advertisers

This Issue 9,000 Copies

ELECTRICAL ENGINEERING

Vol. 47. APRIL, 1915. No. 4.

The Maryville Rotary Converter Station of the Aluminum Company of America

BY C. B. GIBSON.

ALUMINUM is one of the newest of commercial metals and its production as an American industry presents features of interest. During the past few years or since 1908, the annual output of this country has increased from around 6,000 net tons per year to about 36,000 net tons. Practically all metallic aluminum has been produced in the North from Southern ores coming from the states of Tennessee, Alabama, Georgia and Arkansas. The importance of these Southern deposits of bauxite from which aluminum is reduced, is now generally recognized and the production of aluminum known to be an important industrial development for the South.

As a recognition of this fact, the largest manufacturer of aluminum in this country, the Aluminum Company of America, has established a reduction works at Maryville, Tenn., on a 600-acre tract of land in the heart of the Tennessee bauxite section. This company has also acquired title to power rights on the Little Tennessee River from Franklin, N. C., a distance of 65 miles to a point 20 miles south of Maryville, Tenn. The ultimate plans for the production of power to be used in the manufacture of aluminum in Tennessee by this company include the construction of a series of dams, one above the other on the river named so that each will back water nearly up to the toe of the dam next above it. The power thus made available is said to exceed 400,000 horsepower.

Concerning the development of these water powers, a bulletin of the State Geological Survey of Tennessee published during the latter part of last year, has the following to say: "Construction on some of the dams would have probably been started some months ago except for a difficulty which arose over the interference of the water power development with the proposed Murphy extension of the Southern Railroad. For months parties of engineers

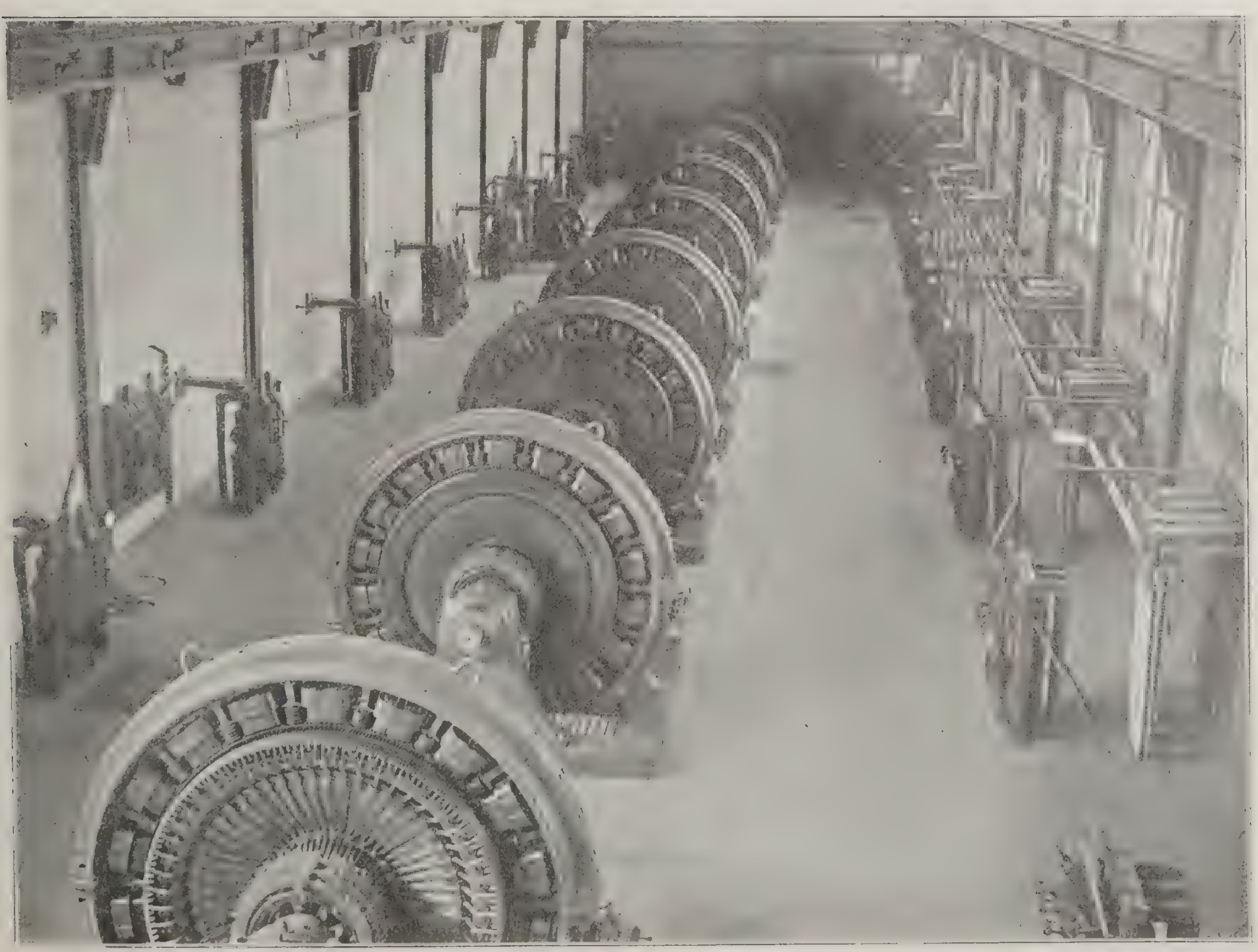


FIG. 1. ROTARY CONVERTERS OF 2,500 KW. EACH AT MARYVILLE PLANT OF ALUMINUM COMPANY OF AMERICA.

representing the aluminum company and the railroad have been at work in an effort to make a satisfactory relocation of the railroad line. This matter has now been settled presumably to the satisfaction of both parties and hence the way has been cleared for construction of the hydro-electric plants to proceed. The first of these plants will be No. 2, (the numeral signifying that the plant will be the second, in point of location, as one proceeds up-stream). It will be located near the mouth of the Cheoah River in North Carolina. The dam will be approximately 200 feet high and the plant will develop about 80,000 horsepower. Dam No. 1, to be located about 5 miles lower down the river, will be the only one of the series situated within Tennessee. In dimensions it will resemble No. 2."

The Aluminum Company of America operates reduction and manufacturing plants at Niagara Falls and Massena, N. Y.; Kensington, Pa.; and East St. Louis, Ill. In 1914 it completed and placed in operation the plant at Maryville, Tenn., the first for treating Southern ore. At this plant as in the various other plants of the company, direct current is used from rotary converters in connection with the reduction processes. At present power is supplied by the Tennessee Power Company under a contract that calls for the use of about 20,000 horsepower.

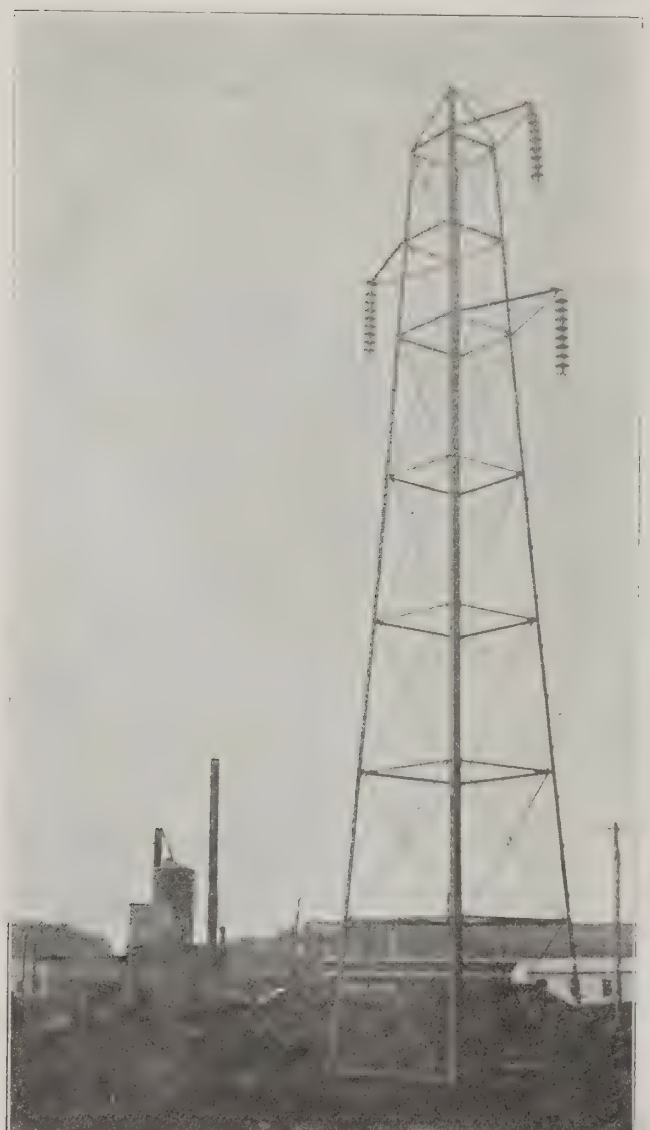


Fig. 2. Archibold-Brady Strain Tower on Maryville-Parksville Transmission Line. Maryville Plant of Aluminum Company of America in Background.

Fig. 3. Archibold-Brady A Type Tower on Maryville-Parksville Transmission Line.

The requirements of the aluminum industry and other processes carried on by electrolysis, demand large quantities of direct current. The installation of equipment for the conversion of an alternating current supply to direct current in quantities as great as 50,000 amperes, constitutes a problem that is peculiar to this kind of work. The Maryville plant electrical installation is the latest solution of some of the problems and its successful operation is evidence of the progress it represents.

THE MARYVILLE-PARKSVILLE TRANSMISSION LINE.

The present arrangement for supplying power to the Maryville plant is by means of a transmission line 70 miles long known as the Maryville-Parksville line, operating at 110,000 volts, 60 cycles and a substation at the reduction plant where the voltage is stepped down through transformers to the voltage required by the rotary converters. Starting from the Maryville end, the transmission line as shown in Fig. 2 extends to Parksville, using A frame towers of Archbold-Brady design and 400,000 cir. mil aluminum cable. At Parksville, the Maryville-Parksville line is connected to a line from the Hales Bar plant of the Chattanooga and Tennessee Rivers Power Company and to a line from Station No. 2 of the Tennessee Power Company. The line can thus be fed from either station. The line from Parksville to Station No. 2 of the Tennessee Power Company is of No. 00 copper. The line to the Hales Bar plant from Parksville to College Junction is also No. 00 copper and from College Junction to Hales Bar of 400,000 cir. mil. aluminum cable. In order to help out Station No. 2 in case of break down or other emergency, there is a tie line between Parksville and the No. 2 station connected to a

transformer at No. 2, by which power from the Parksville station at 66,000 volts, can be supplied through station No. 2 and to the Maryville line at 110,000 volts.

The delivered power at the Maryville plant is converted to 500 volts direct current by the use of eight 2,500 Kw. 60 cycle, commutating pole rotary converters shown in Fig. 1 and operated in two groups of four units each. These converters are one of the interesting features of this plant as they are the largest 60-cycle machines now in operation. Other units of a larger capacity have been built but are not yet in operation. In addition to the eight rotary converters, there is one spare machine which is so arranged that it can be connected to either group of converters. To start the rotary converters, one machine is first started by means of a direct connected induction motor, and the remaining machines are then started from the direct current side by an automatic controller using power from the machine first started.

The seven transformers installed include one spare, and are each 3,600 Kva. capacity, single phase, water cooled, of the outdoor type as shown in Fig. 5. These transformers are connected in two banks, each bank consisting of three units, connected in delta on the high tension side, and diametrical on the low tension side. Each bank is connected to a group of four rotaries, operating in parallel on the direct current side. The low tension winding of each transformer is provided with four separate and individual windings so that the rotary converters are not electrically connected on the alternating current side with one another. Taps are provided on the low tension side of the transformers for operating at 60 per cent and 80 per cent normal voltage. As it is sometimes desirable to reduce the amount of power taken from the transmission line, the range in voltage permits the direct current rotary voltage to be reduced, without reducing the direct current output per group.

A very ingenious arrangement has been employed in bringing out, through the case, all the low tension leads so that it is unnecessary to open the transformer to change any of the low tension connections. Each transformer is provided with an iron base with wheels so that it can be

Fig. 4. Receiving End of Transmission Line Serving Maryville Plant.

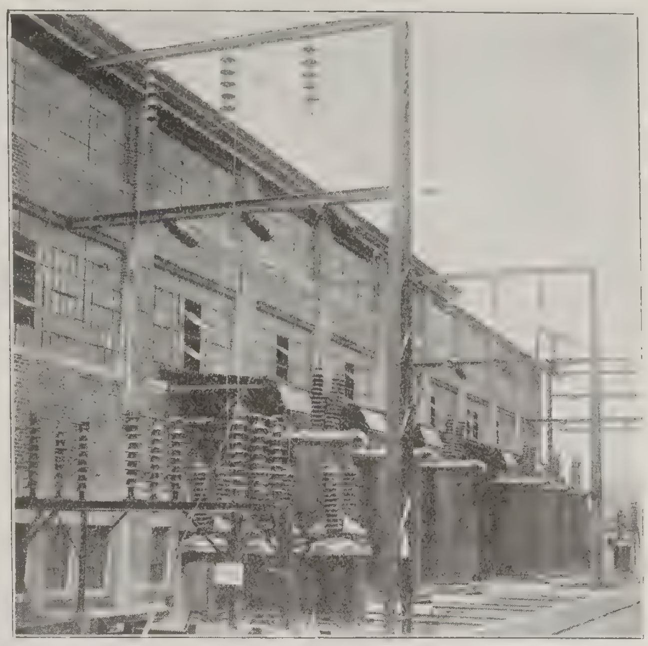


Fig. 5. Step-Down Transformers at Maryville Plant.

easily moved. Another interesting feature in connection with this installation is the oil drying system for maintaining the transformer oil in proper condition. This oil drying system is permanently piped to each of the transformer tanks and the oil of any transformer can be treated as desired.

The protective apparatus is of the outdoor type and consists of two 3-pole, 120,000 volt, electrically operated oil circuit breakers together with outdoor-type disconnecting switches, electrolytic lightning arresters and choke coils. The arrangement of this equipment is shown in Figs. 4 and 5.

The switch gear controls the incoming 110,000 volt line, step-down transformers and the rotary converters. The control desk and instrument frame consists of 10 sections for the control of the alternating current and direct current ends of the rotary converters and the high tension circuits. On the instrument frames are located the usual complement of instruments and on the top of the control desk the drum type control switches, red and green indicating lamps, synchronizing and voltmeter receptacles and selector switches for connecting the operating circuit to the proper group of rotary converters. On the rear of the desk are mounted the auxiliary control relays and watthour meters.

For the control of the alternating current side of the rotary converters are nine 2,500 ampere carbon break circuit breakers, 3-pole, solenoid operated, automatic type as shown on the right of Fig. 1. The direct current boards consisting of 15 panels for the control of the rotary converters, are shown on left of Fig. 1. On eight of these panels are two 5,000 ampere carbon break circuit breakers, single-pole, solenoid operated, automatic, together with relays, ammeters and the necessary magnet switches for connecting converter to the starting bus. The panel for the spare rotary converter is so arranged that this machine can be connected to either of the two positive bus bars, there being a common negative bus for the entire installation. Four panels are provided for the two feeder circuits and two of these panels are provided with 20,000 ampere single pole automatic solenoid operated circuit breakers which are the

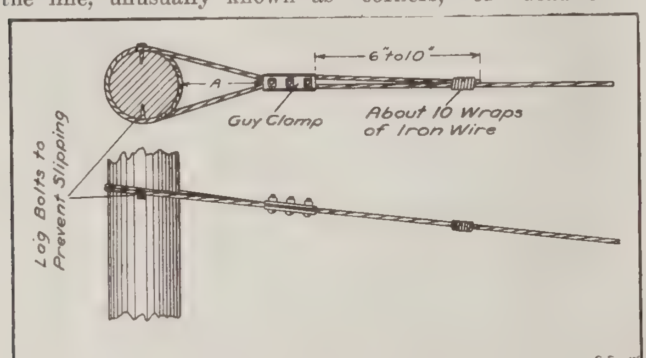
largest breakers of this type ever built. The other two panels are provided with 10,000 ampere breakers of similar type. Two other panels are provided, one for the control of the storage battery system feeding the control circuits and the other for the automatic starter for the rotary converters. A separate direct current switchboard is provided for station lighting, auxiliary power for cranes and machine tool motors.

The complete electrical equipment for the Maryville plant was furnished by the Westinghouse Electric and Mfg. Co., of East Pittsburgh, Pa., which company has been a pioneer in the development of this class of apparatus.

Practical Methods for Laying Out and Building Transmission Lines

BY E. B. HOOK, JR., SUPERINTENDENT OF CONSTRUCTION, GEORGIA RAILWAY AND POWER COMPANY.

With the poles set and cross armed, the next step is one of the most important features of construction, and one which is often carelessly or insufficiently done. This is the guying of the line, and it generally reflects the character of the whole construction. By guying is meant the external reinforcement of line structures to help resist unusual strains of a permanent character, such as angles in the line, unusually known as "corners," or "dead ends"



Figs. 6 and 7. Methods of Attaching Guys to Poles and Stubs.

to branch circuits, etc., or transient strains due to extreme weather conditions, wind and ice stresses, etc. These two classes are generally known as line guying and storm guying. The top of the guy should be fastened to the pole directly under the cross arm when pin type insulators are used, and as near the cross arms as possible to give a safe distance from the conductors when the insulators are suspension type. Two lag bolts are driven into opposite sides of the pole to prevent the guy strand from slipping down. The free end of the wire should pass twice around the pole, loop under the first turn so as to bind the pole, and fasten back on itself by means of a suitable guy clamp. The lower end of the wire is attached to a guy stub, anchor or slug strongly imbedded in the ground and sufficient to resist a pull equal to the breaking

Note:—This article is continued from the March issue.

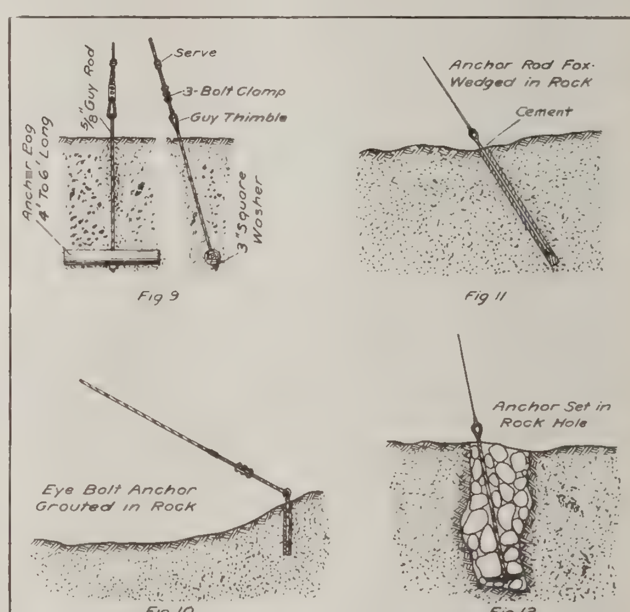


Fig. 9. The "Dead-Man" Type of Anchor. Fig. 10. Eye-Bolt Anchor Grouted in Rock. Fig. 11. An Anchor Rod Fox-Wedged in Rock. Fig. 12. Anchor Set in Rock Hole With Cement.

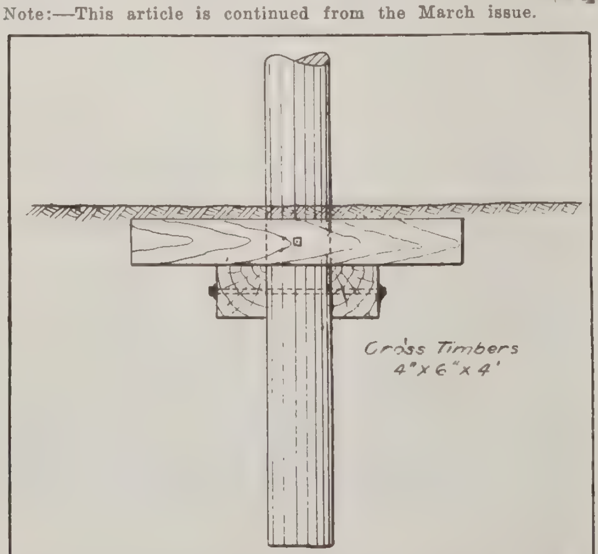


Fig. 8. Construction for Base of Poles in Wet Ground.

stress of the guy strand. This end should also be doubled back and fastened with a clamp, the ends of the guy wire being allowed to extend eight or ten inches beyond the end of the clamp and lightly made up to the guy proper by serving with a few turns from one of the strands of the wire. These connections are shown in Fig. 6.

Strain insulators should be made up in the guy. Clamps may be used for this purpose if desired, but a good scheme is to have the men serve up the cable on either side of the strain insulators when weather conditions prevent outside work. When fastening the guy to the anchor the slack is pulled out of the guy with a small pair of double blocks and a "come-a-long." It should be pulled taut enough to rake the pole back a few inches so that when the strain is put upon it the pole will stand perfectly straight.

Various kinds of wires are used for guying, and a very considerable difference in size is found in general use.

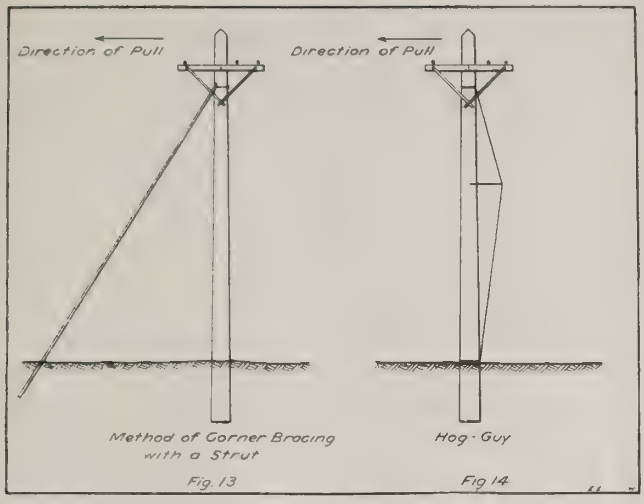


FIG. 13. METHOD OF CORNER BRACING WITH A STRUT.
FIG. 14. A METHOD KNOWN AS HOG-GUYING.

The most popular guy wire, however, seems to be stranded galvanized steel wire, ranging in size from 0.25 inch, with a breaking stress of 2,000 pounds, to 0.37 inch strand with a breaking stress of 5,000 pounds. The 5/16 inch strand, with a breaking stress of 3,800 pounds is generally used, and has proven sufficiently strong for all ordinary pole guying.

A number of types of strain insulators are being used, also compression strain insulators, made of various insulating materials. Generally, specifications call for a strain insulator so constructed that a failure of the insulator does not lead to a failure of the guy. It is advisable to use insulators of a mechanical strength considerably higher than the strength of the guy wire because they undoubtedly deteriorate when under stress. The electrical strength of these insulators should be high enough to take care of the full line voltage, and an extra precaution is to insert two strain insulators in every guy, one out of reach of a man on the pole, and the other out of reach of a person on the ground.

There are numerous patented guy anchors on the market. Among them are the screw type, the scoop or flat expanding plate design that is screwed into the ground with an auger tool, and various kinds of harpoon designs. Another design which has proven a very hard anchor to uproot, is one composed of a hollow cone about 8 inches in diameter with a six foot ⅝ inch round iron rod bolted through the apex of the cone. This anchor is placed in the hole with point up and a few rocks the size of a half brick tamped around the edges of the cone. When the hole is filled with earth and well tamped, the anchor wedges tightly when a strain is applied to it. These patent anchors have their sphere of usefulness, and when large enough to give effective bearing area are quite satisfactory for ordinary classes of work. With heavy transmission work, however, the safest method is undoubtedly the best, and the "dead man" type of anchor is generally used. The "dead man" usually consists of a piece of pole or heavy cross arm four or five feet long, buried five to seven feet in the ground. A galvanized anchor rod should be run through the slug and secured with a nut and large washer as shown in Fig. 9. The use of this class of anchor is quite expensive on account of the necessary digging, but is well worth the expense to secure the stability of the line.

Sometimes it is necessary to set anchors in rock, and several methods are used for doing this. If the rock is hard and solid, an eye-bolt 10 or 12 inches long grouted in a chiseled hole will give very good results if the bolt is well nicked to prevent slipping and properly set up in neat cement as shown in Fig. 10. When the rock is soft or stratified, an anchor rod with its end fox-wedged into a hole 3 or 4 feet deep and set in neat cement is quite satisfactory as shown in Fig. 11. If the strain is unusually severe a 5 foot hole should be blasted and a screw anchor set in with heavy rocks bonded together with cement as in Fig. 12.

The angle the guy wire makes with the pole should be at least 20 degrees. When for any reason there is not room to carry the anchor far enough away from the base of the pole to bring the angle to 20 degrees or more, some other method should be used for reinforcing the pole. A strut, consisting of a pole slightly shorter and lighter is framed into the line pole near the top and buried in the ground a short distance from the base of the pole on the opposite side from which a guy would have been fastened. This construction is shown in Fig. 13. This strut makes a good, substantial corner, but is expensive if used in quantities. Another method known as "hog guying" takes very little room, but is less substantial than the strut. In this method a brace about 3½ or 4 feet long is fastened to the pole a short distance above the middle. The guy strand passes over the end of this brace and is pulled taut to the butt of the pole, as shown in Fig. 14.

Another way of bracing poles in a close place is to bury a stout piece of timber at right angles with the bottom of the pole on the "kick" side. This method is known as "cribbing" and shown in Fig. 15. If the corner is very sharp, a second piece of timber may be placed just below the ground line on the opposite side of the pole.

A very neat and substantial method of angle construction with suspension insulators is illustrated in Figs. 16 and 17. This type of corner construction has been extensively used by the writer and it works out very satisfactorily. The condition obtained by this type of corner construction allows the guy to be attached at the point of the resultant of the strains caused by the deflection of the wires, and with the minimum amount of materials made

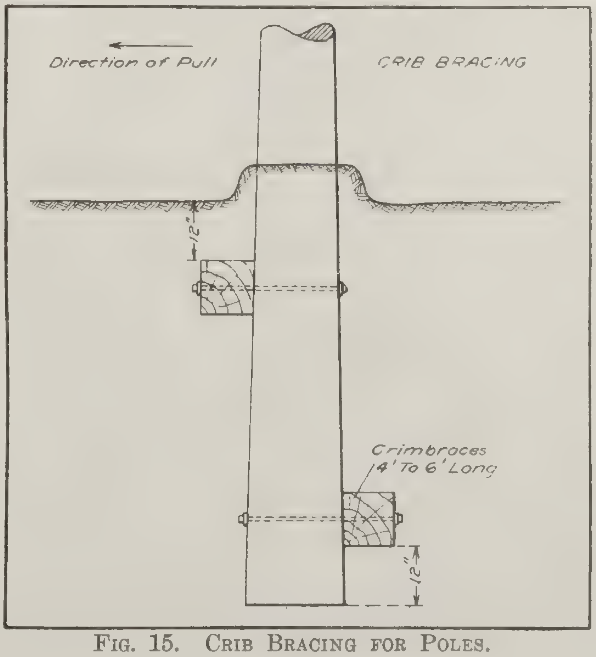
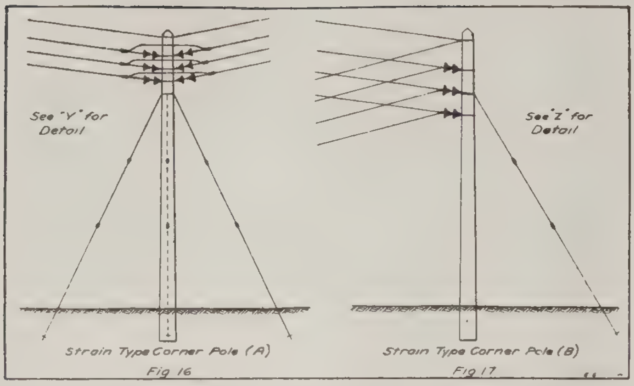


FIG. 15. CRIB BRACING FOR POLES.

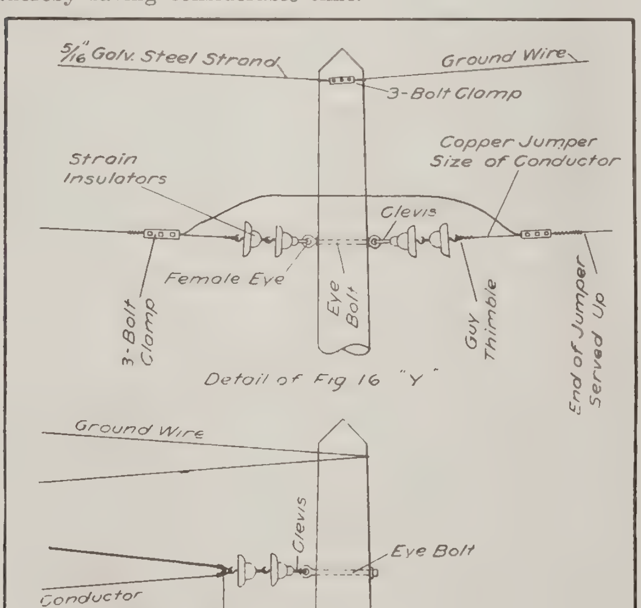


FIGS. 16 AND 17. SUBSTANTIAL ARRANGEMENT FOR ANGLE CONSTRUCTION.

possible, the effect is very good and very desirable. Care must be exercised with this class of corner construction to install ample insulation, as experience shows that this type of corner subjects the insulators to severe stress from lightning and other momentary line surges of a steep wave front.

Head guying in the direction of the line is used when abrupt changes of level occur, also for extra long spans and end poles. The head guy is attached at the top of one pole and runs back to a point near the base of the next pole. Storm guying is often used at about half mile intervals for stiffening the line. A storm guy is composed of four guys, two at right angles with the line on either side of the pole, and two at right angles with these, in both directions with the line as shown in Fig. 20.

While the line is being guyed, the material teams should be distributing insulators. If suspension type insulators are to be used, they should be hung before the cable is pulled out, but if pin types are used the lineman can screw them on as he goes up the pole to tie in the cable, thereby saving considerable time.



FIGS. 18 AND 19. DETAILS OF CONSTRUCTION SHOWN IN FIG. 16 AND 17.

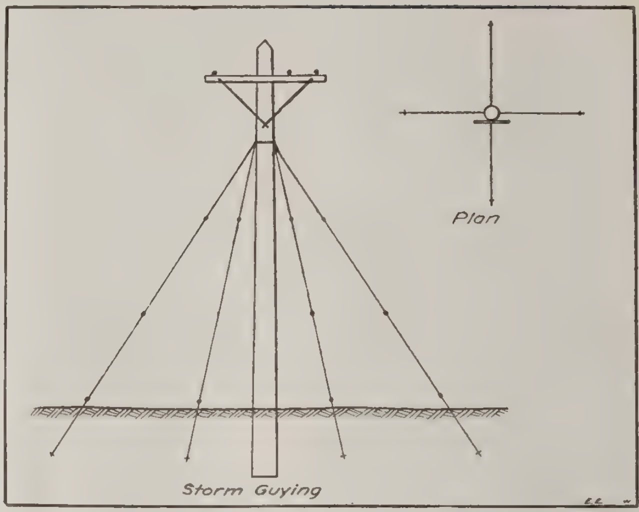


FIG. 20. CONSTRUCTION FOR STORM GUYING.

Electrical Development in the Far East.

According to Consul E. Carleton Baker, there are great potential possibilities for electrical development in Szechwan Province of China; many of its cities have excellent water powers close at hand, the cost of kerosene and other illuminants is very high, and in numbers its population exceeds that of any other Province. Szechwan also is very wealthy, and sooner or later there is usre to be an era of vast commercial development. Large industrial projects are under consideration, and electrical equipment of all kinds will some day enjoy a very large sale.

Owing to unsettled conditions in China and the war in Europe, the trade of this Province is becoming very slack; adverse exchange and increased prices of foreign articles have caused imports to dwindle. Chinese capitalists, too, have grown timid and hesitate to invest in industrial undertakings. A few years ago the installation of an electric-light plant in the city of Tzechow seemed assured; part of the capital had been subscribed and negotiations had been opened for the appointment of an American electrical engineer. The revolution of 1911 and the local insurrection of 1913, however, caused those interested to abandon the idea. Recently an influential resident of Tzechow, when requested to give his opinion as to the present and future demand for machinery, stated: "At present, no demand. There is talk of electric-light plants for the city and pumps for the coal mines." The promotors of these schemes do not seem to have gotton beyond the "talking" stage; yet the situation at Tzechow is more encouraging than in other parts of the Province.

What the Chinese need most at the present time is money. There are many industrial enterprises that would prove highly profitable, but there is no way to finance them. The Chinese are anxious to develop the country, and many towns would install telephones and electric-lighting plants if sufficient money could be obtained. The sale of electrical machinery should, in many cases, be accompanied by a loan, and the companies that adopt this method will very likely secure the bulk of the trade. There is a possible market in this Province for the sale of small lighting plants for theaters and other large buildings. Many private users of current find it advantageous to maintain their own lighting sets; the American Methodist Mission in Chungking has done this successfully for several years, and the Canadian Methodist Mission at Chengtu has plans for a private plant.

Armature and Commutator Troubles—Their Cause, Effect and Repair

BY ALEX R. KNAPP.

Section. 1. Armature Troubles—Causes and Tests.

IN the following article no attempt is made to go into the details of armature design, or to explain how the different forms of winding formulas are worked out. The average man in charge of the electrical equipment of a plant is familiar with the various classes of windings used, and this article on the repair of armatures and commutators is intended for the man on the job as a help in locating and remedying such troubles when they come up.

In all but the smallest of plants, a man is usually employed to take charge of the electrical work. By reason of the delay occasioned, and the charges made by some repair dealers, it becomes necessary in a factory of any magnitude to be prepared to do repair work. Two methods herein described for testing and locating defects in armature work are simple, only such electrical instruments as are found about the average manufactory being necessary.

The common causes of trouble in armatures are practically the same as in any electrical circuit, viz: short-circuit in or between coils, open circuit, reversed coil, and grounds. Of all the faults inherent to armatures, probably the most dangerous is the short-circuit between coils, which, if not detected and remedied as speedily as possible will result in the burning out of the coils affected, and probably the whole armature.

There are numerous ways in which short-circuiting of coils may occur. In the case of wire-wound coils, it sometimes happens that one of the turns forming the coil becomes twisted during the process of inserting the coil in the slot, and in order to force the winding down to an even depth, the turn of wire will be driven down upon other turns, cutting through the insulation and causing a short-circuit between turns of the same coil. When this occurs, the resistance of the coil is reduced, allowing more current to flow, increasing the temperature of the coil and eventually causing a deterioration of insulation on other wires at this point, and in the majority of cases, short-circuiting the entire coil upon itself.

Also a frequent cause of trouble is the short-circuit between coils. This is often caused on the back end of the armature by oil soaking into the coils by leakage from the out-board bearing, which, together with the dust that will invariably work in between the windings, break down the insulation and cause an electrical leak between coils. A short-circuit may also result from the top and bottom armature leads coming in contact with each other. A short-circuit between commutator bars is often the cause of burnt out coils. In soldering leads to the commutator, great care must be exercised not to allow any of the molten solder to run down behind the bars, as this very frequently short-circuits the bars. A good way to avoid this is to raise the back end of the armature a trifle which will run the solder to the front where it can easily be removed.

Probably the best way of first detecting the presence of a short-circuit in the armature of a motor is upon starting. Sometimes the armature will not start upon the first few points of the rheostat, and will then take an excessive current, which will cause it to run with a slow and unsteady motion (especially at low speeds), due to the fact that every time the short-circuited coil comes under the influence of a pole, it will have a tendency to retard the motion of the armature. By running the motor for a short time, the bad coil will heat much more than the others, and its location can usually be detected by passing the hand over the end windings.

Another way of detecting a short-circuited coil is to hold a thin strip of iron near the revolving armature. Even if there is no trouble the iron will vibrate slightly, but should there be one or more faulty coils, the iron will be caused to vibrate very perceptibly.

OPEN CIRCUITS.

An open circuit may result from a number of causes. In the first place, when the armature was wound, a coil may have been driven into position in such a manner that one of the wires was strained or partly cut in two. The momentum of the armature, and constant vibration of the machine will finally break the wire, and in this way form an open circuit. Sometimes an open circuit of this kind will only show when the armature is up to speed, the centrifugal force causing the wires to separate, thus opening the circuit. When the motor is at rest, the wires will come together again, and a test will reveal nothing. This condition is known as a flying open-circuit, and occurs quite frequently. The same state of affairs may result with a short-circuit between overlapping coils.

The armature leads should not be drawn too tightly when they are soldered to the commutator, as they are apt to break off due to expansion and contraction of the wire from the constant heating and cooling.

A common cause of open circuit results from poor workmanship when the leads are soldered to the commutator. If the lugs or risers are not perfectly tinned before attempting to solder the leads into them, the solder will not take hold over the entire area, and a lead may be held in place only by a thin film of solder on the outside surface. If the current through the armature is heavy, the contact area between the riser and the leads may not be sufficient to carry the necessary current without excessive heating, which will melt out what little solder there is, and an open circuit occurs. Sometimes a commutator will become so hot from excessive brush friction, resistance drop, overloads, or the like, that it may throw solder, and cause an open circuit in this manner.

The symptoms of an open circuit are very prominent. A vicious greenish-purple spark appears at each brush as the open circuited coil passes from one pole to the next, it having a tendency to leap out from the brush and follow around the commutator for quite a distance. The bars to which this coil is connected will be found to be burnt and roughened, and the mica insulation between eaten out to a considerable depth.

In a lap wound armature the position of an open cir-

cuited coil is easily located, because each end of the coil is connected to adjoining bars. In a series winding this is not the case. Each end of a coil is connected to a bar removed a certain distance around the commutator from the other, depending of course, upon the number of poles and the winding pitch employed.

GROUNDS.

A ground occurs when current leaks from the current carrying parts of the armature into those parts that are not intended to carry current. A single ground will have no effect on the operation of a motor, but it should be removed as soon as possible, as there is always danger of a second ground coming on at some other point, which would produce the same effect as a short-circuit. When a ground occurs, there will be found a small hole burnt through the insulation and into the iron parts of the armature. Across this carbonized insulation, current will pass. Grounds occur very frequently on the ends of the armature core at the points where the coils leave the core. If the bend has been too sharply made, or has been hammered too closely, the sharp edge of the core will cut through the insulation. To avoid this, the slot insulation should extend about one-eighth inch past the end of the core on each end.

The writer had occasion recently to examine a grounded armature. The trouble had formed on the rear end, and the small arc had played across from the coil to the armature core so consistently that two of the four turns of wire forming the coil had been melted completely in two. In this case an open circuit was the result of the original ground.

Grounds frequently occur on the commutator, the result of oil creeping up on the mica ring. Combined with the customary copper and carbon dust from the commutator, this forms a good path for a leakage of current.

TESTS AND REPAIRS.

When a short-circuit is suspected in an armature, the only thing to do is to shut down the machine at once, locate the defect, and make the necessary repairs. One method of locating a short-circuit is to disconnect all the leads from the commutator and test out the coils with a test lamp. A test lamp consists of two wires about six feet long, connected to a source of power, with which an incandescent lamp is connected in series in the circuit. This method requires a great deal of work in unsoldering all the leads, which may not be necessary. In the majority of cases, the root of the trouble will be found to be within the commutator itself, due to short-circuits between bars.

A practical and rapid test which will locate the trouble exactly without disconnecting any of the wires during the test, is the bar to bar test. This test can be applied to armatures with any style of winding connections, for there will be exactly the same drop of potential between any two adjacent commutator segments no matter which scheme of connection is used. Fig. 1 shows the connections necessary for a test of this kind. A steady current, taken from the power mains, is sent through the armature at opposite sides of the commutator. The brushes B should only be wide enough to cover one bar. C is a fiber block holding the copper contact fingers, so spaced as to rest on adjoining segments as shown. Adjust the lamp bank until the voltmeter gives a readable deflection when C is in contact with what are supposed to be good coils. The deflection of the voltmeter will depend upon the difference of potential between the bars. If everything is all right,

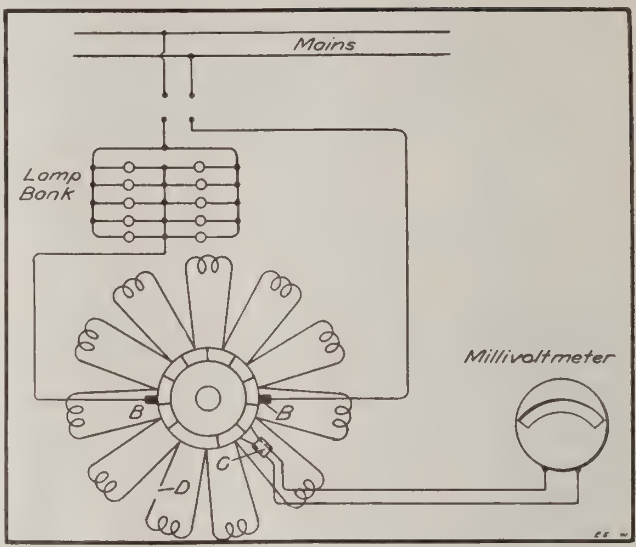


Fig. 1. Connections for Testing Out Short-Circuits in Armature Coils.

practically the same deflection will be obtained all around the commutator regardless of what pair of bars C may rest upon. Pass the fingers over each pair of bars and note the deflection on the voltmeter. When the short-circuited coil to which the bars are connected come under the contacts there will be very little if any movement of the needle, because there will be little or no drop through the coil.

When the coil at fault is found in this manner, its leads should be disconnected from the commutator, together with the leads adjoining it on either side. The commutator should now be tested by use of the test lamp to determine if the bars to which the coil was connected are short-circuited.

The bands should be removed from the armature and the defective coil taken out by raising the top sides of other coils clear of the armature as far around as the bottom sides of the damaged coil, when it can be lifted out. Most likely the insulation on the wire of the coil has reached such a stage of deterioration that a new coil will be necessary, in which event a new one should be formed with exactly the same number of turns and size of wire as the old one. Care should be taken not to wrap a thicker layer of tape on the new coil than was on the old one, for if this is done trouble will be experienced in forcing the coil back into the slot. The finished coil can be given a coat of insulating varnish. It is a good plan to re-insulate the armature slots also, before returning the coil. If the commutator is free from short-circuits the coil may be replaced, and the raised coils returned to their slots. The leads should now be soldered to the commutator again.

If an open circuit exists in an armature for any length of time, the burned condition of the commutator bars will usually indicate where the trouble is located. Sometimes a test is desired before destructive flashing occurs. Both parallel and series wound armatures may be tested for open circuit by use of the ordinary test lamp, and making a bar to bar test. Test the commutator from bar to bar and note the brightness of the lamp on each pair of bars. When the bars are reached to which the open circuited coil is connected, the light will dim considerably, and may go out, depending upon the resistance of the winding. When more than one coil is open circuited, the winding will be divided into two or more sections, and the test lamp will

only light when the test leads are in connection with bars in each section.

The testing set described above for locating short-circuits may also be used for open circuits. Proceed in the same manner as when testing for short-circuits. When the contact fingers C (Fig. 1) are connected to the open-circuited coil (indicated at D), there will be a violent throw of the needle, because the voltmeter will then be connected to brushes B through the intervening coils. When C is moved to the next segments, there will again be no deflection, thus locating the break definitely.

If an open circuit results from a lead breaking off at the commutator, it is an easy matter to solder it back again. When the break occurs within the coil proper, a new one must be substituted, as outlined above for short-circuit.

In case of emergency, the bad coil can be cut out of circuit and the commutator bars connected together by a wire large enough to safely carry the current. This wire should be well insulated from the other leads, as any connection with them would constitute a short-circuit.

Fig. 2 shows the method of bridging out in a series winding. One of the coils is short-circuited as shown at A. The top side of the coil is disconnected from bar B, and the bottom side from bar B^1. The jumpers should be soldered in as shown by the dotted line. The ends of the coil leads are then cut off close to the armature core and taped. The coil should be cut completely in two at X and X^1, and the ends taped. This will prevent self-induce currents from being generated within the coil, which might cause heating and injure the insulation on other good coils.

Fig. 3 shows how a coil is cut out in a parallel or lap winding. A coil is open-circuited at A. The top side of this coil is disconnected from bar 3, and the bottom side from bar 4. In this case the jumper is run from bar 3 to bar 4. The dead coil can be treated the same way as the series coil mentioned above.

One coil cut out of an armature will not perceptibly affect the running of a motor, and several of them can usually be cut out with safety, providing they are not bunched together. It is not wise to cut out too many coils, as this increases the heating and speed of the armature and lowers the efficiency of the machine.

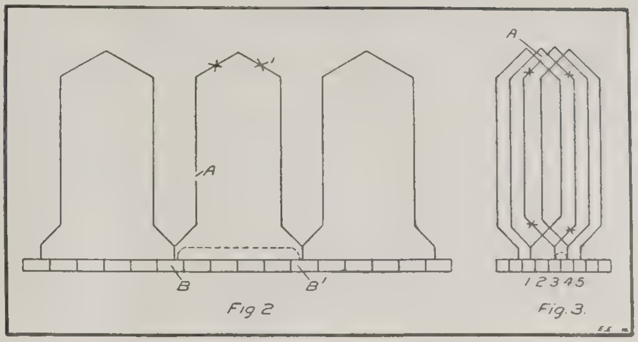


FIG. 2. METHOD OF BRIDGING COIL OF SERIES WINDING.
FIG. 3. METHOD FOR CUTTING OUT COIL OF PARALLEL OR LAP WINDING.

A ground can usually be located by using the test lamp. Disconnect the leads from four of the commutator bars on the quarter. This will determine the quarter of the winding in which the ground is located. Raise the leads of the defective section out of the commutator. Place one wire of the test lamp on the shaft, and with the other, test each coil separately, and locate the ground. Sometimes the trouble may not be in the armature, and may be caused by a grounded commutator. If the coil is at fault, it should be removed and reinsulated.

A reversed coil, that is, the leads to the commutator being connected reversed, frequently occurs. A practical way of locating a reversed coil is to pass a current through the armature at opposite points. The lamp bank referred to can be used. Then with a compass or small bar of magnetized steel explore around the armature the direction of magnetism from slot to slot. When the compass is over the reversed coil, the needle will reverse, giving a very definite indication of the coil connected wrong. Reversing the leads is all that will be necessary.

The next section of this article will take up the rewinding of armatures.

Iron Conduit Work for Interior Wiring and Possible Fire Risks

BY V. C. WYNNE. CONSULTING ENGINEER, ALBANY, N. Y.

Section 2. Suggestions and Methods for Eliminating Fire Risks in Electrical Wiring.

The fire risk from accidental grounds develops usually in one of two ways, namely either by short-circuit or by arcing. When the conduit system is itself properly "grounded," and when only one conductor within any conduit of the system comes into contact with the conduit or with any metal box or fitting forming part of the system, as a rule nothing happens. If another conductor, however, of the same system but of differing polarity is already or becomes also similarly grounded, either at or near the same point or at any other point of the conduit system—or is intentionally permanently grounded at a transformer, switchboard, or other distributing point—a short circuit occurs at each point of contact, varying in intensity according to the carrying capacity and resistance of the circuits concerned, and of the fuses which protect same. As stated above, such short circuits within the conduits or boxes are not usually likely to lead to serious fire risk, provided the circuit fuses are small enough to be immediately blown without danger of destroying the conduit or the ground wires and connections.

However, in cases where the conduit system is not properly interconnected and grounded, the danger from fire is very much greater; for in such case we have the likelihood of getting sparks upon the outside of the conduit, due to accidental grounding at two or more points of the system. It is true that for a long time the Underwriters' rules have required all conduits to be electrically interconnected and grounded, but until comparatively recently—at least in a number of sections of the country—this regulation has been almost overlooked or at best but rather indifferently en-

forced. Fortunately, most inspection departments seem now to be giving this feature more careful attention.

The average workman or contractor sees very little point in grounding the conduits—except as being required by "the inspector"—and it is not always easy to make this necessity clear by object lesson. Two instances of trouble are described here to illustrate the sort of thing which can easily happen with an imperfectly grounded conduit system. In one case the writer was engineering an installation of motors in a cotton mill, for which he had specified all wiring to be in continuous iron conduit and all conduits, boxes and motor frames to be thoroughly electrically interconnected, and to be well grounded at a sufficient number of points as directed. As the conduits were galvanized outside, and were hung by iron hangers attached to the mill ceiling and to steel beams, etc., the contractor seemed to think that the conduit ought to be considered sufficiently well grounded without making all the special ground connections specified and possibly he might to this day have felt that considerable injustice had been done to him, and a lot of needless expense put upon the mill owners, by the engineer in charge insisting upon such grounding connections, if an accident had not happened, before the work of installation was finished, which made perfectly clear the necessity for such careful grounding. It was necessary to get one motor after another running temporarily as soon as possible and before all other circuits were complete, and before the conduits had been fully interconnected and grounded or any of the wiring had been properly tested. During this work one of the workmen was engaged at a running motor, using a screw-driver to pry over one of the terminals to better position or something of that sort, so that he grounded the terminal to the conduit or outlet-box by means of the screw-driver. There was a short-circuit flash which nipped off a piece of screw-driver but did no other harm at that point. However, at the same instant, at a point about a hundred feet away, a morsel of burning cotton fell from the ceiling to the floor below, but was fortunately at once noticed and extinguished before it had time to reach the masses of cotton on the machines and exposed in cans, etc.

On investigating the matter a little later, the writer found that the other "ground" of the short-circuit had occurred in a junction-box upon another floor, in which a joint had been roughly made and poorly taped, so that a jagged point of solder had forced itself through the taping and had come into contact with the cover of the rather over-crowded box. The electrical connection between this latter box and the motor at which the workman was engaged was then through the steel construction work of the mill and through the imperfectly grounded conduit connected to the motor and at the time of the screw-driver grounding the latter conduit to one wire, a spark had been formed at a loose contact between the conduit and a hanger attached to a steel beam, and had set fire to a small accumulation of cotton lint at that point. This might have turned into a serious accident if a workman had not been on hand where the burning cotton fell, or if any cotton below had been lying around loose and not in proper receptacles.

In another case an incipient fire had occurred from an "obscure" cause, in the ceiling over a basement pantry or closet in a large residence. It could not possibly be due to defective wiring—at least so the contractor said—for the wires and fuses of the circuit nearest to the trouble were still intact after the fire. On looking over the building some time afterwards, however, the writer found that another circuit from the same panel box was running very well upon only one fuse (the other being out or blown) and that the other path to the first outlet was being supplied by the conduit itself. Now in such a condition, where there are several conduits and gas pipes loosely touching each other, it is very easy to get sparking between conduits, or between conduits and gas pipes, if one conduit becomes grounded to one polarity while the adjacent conduit or gas pipe is grounded to an opposite polarity, and this appears to have been the real cause of the fire in question. Of course the added combination of a very small leak of gas near the sparking point would be ideal as a fire starter. To avoid any possibility of such sparking, all conduits should be not only thoroughly interconnected in plain sight, and the whole well grounded, but also all gas piping touching or in the immediate vicinity of conduit work should be well electrically interconnected thereto, so as to prevent the possibility of any appreciable difference of potential between any of the pipes, which might at any future time come into direct or indirect contact with each other.

This precaution is necessary in all cases, and perhaps even especially so in installations of 3-wire system with grounded neutral, and in 2-wire low-voltage A. C. systems where one side of the system is permanently grounded.

As a fire risk a loose contact or other form of continued sparking is usually more dangerous than a decided short circuit, when wires are properly fused.

ARCING.

Arcing may be either entirely within the conduit system or also partly on the outside of the conduit. The latter can occur only in case of ungrounded or imperfectly grounded systems, as described above. The distinction here made between "short-circuits" and "arcing" is that the latter may be kept up for a considerable time by reason of the current passed not being of sufficient amount to blow the fuses of the circuit or circuits concerned and this would always be the case where of two accidental contacts (or "grounds") to the wiring system, one was made through a lamp or group of lamps, or other limiting resistance, so that this contact would temporarily form a single-pole switch to feed the light or lights, etc. In such case, where the accidental contact is loose or imperfect, heat is generated at the contact point, and the imperfect contact may become burned away and an arc started. Such an arc gradually grows longer and longer, until it gets beyond its maintaining length, and finally goes out. On a 110 volt system such an arc may easily start with a current of even one-half ampere (say a 60-watt lamp or equivalent) and even this would be quite sufficient to start a fire if it were immediately exposed to inflammable material. Of course an arc with a heavier current would develop correspondingly more heat and would draw out further and continue longer. It should be noted that, for this class of trouble, direct current is more dangerous than alternating current, as direct current will start an arc more readily than will alternating current of same voltage and amperage.

In one case which the writer had occasion to investigate, a fire had got under good headway from this cause, and the building concerned was only saved by prompt action. The circuit concerned fed lights in a dormitory on the top floor of a building for insane patients, and only a ½ ampere night-lamp was burning at the time. The nurse

in charge had noticed the lamp burning dimmer, but thought nothing of it. However, finally the light went out, and soon afterwards the nurse noticed—by the light from another lamp in the adjoining hall—that a spot in the room ceiling had turned brown, on running up to the attic above, she found the attic floor and rafters in flames. On investigating carefully the cause of the fire, later, it was found that the conduit of the circuit in question had become heated red-hot for a distance of about 18 inches, and had set fire to the wood joists to which it was fastened. The heating of the conduit was due to an arc started inside of the conduit by one or both of the circuit wires becoming broken and drawing slightly apart. At first the arc was in series with one lamp burning, and could not exceed ½ ampere. This arc must soon have burned itself out, and the lamp went out but in the meantime, the heat had carbonized the insulation of the wires, and the current now passed from the first arcing wiring directly to the adjacent wire of opposite polarity. This action evidently continued for some time, until the wires had burned gradually back in the conduit, away from the lamp and towards the wall-switch controlling the circuit, to a distance of nearly two feet from the starting point, by which time the current passing between the wires had gradually increased until at last it was great enough to blow the six-ampere fuses feeding this circuit. In the meantime the heat generated had been so great and had lasted so long that it had made the conduit red-hot and set fire to the adjacent woodwork. The original cause of the breaking of the wire in the conduit is rather problematical, but from careful examination of the rest of the wire of the circuit when withdrawn, it seemed clear that the contractor's man had got a kink or loop in his wire (it was No. 14 duplex) through gross carelessness in handling, and that he had forced the wire—kink and all—through the conduit, so that he must have pulled unduly hard and finally either stretched or actually broken one of the wires at the point where the arc eventually started. As this point was not far from an outlet box, there was ample chance for a broken wire to close itself (the insulation not having been broken) upon easing up in pulling. A very small section of stretched wire, or a very small steady contact between broken wires, might have carried a ½ ampere almost indefinitely without showing the defect, but the night in question was an intensely cold one and apparently the wires had gradually shrunk just sufficiently to separate them very slightly and start the arc.

Other somewhat similar instances of fires being started by iron conduits have come to the writer's notice but he has not had the chance to personally learn all details of the circumstances. Fortunately this kind of thing does not occur very frequently, but it is a very serious thing to know that it can ever occur, as in some cases the results might be disastrous.

The writer has given a great amount of earnest thought in endeavoring to find some way to absolutely prevent the repetition of such a case, without having to specify any special style of construction which would materially increase the cost; but his conclusions are not yet sufficiently definite to justify stating them here. It is, however, well to emphasize the obvious truth that the safety of an installation necessarily depends fully as much upon careful and conscientious workmanship, and upon rigid inspection during installing, as it does upon the superior quality of wire and other materials used, or even upon the careful designing of the system at large and of the details of same. The above instance is described here at some length in the hope that other engineers who have the opportunity will give careful consideration to the facts and inferences stated, with a view to determining the best and most simple methods for making occcurrences of this sort not only very unlikely but even practically impossible.

Some Problems Met and Solved by an Electrical Trouble Man

BY J. A. HORTON.

Some Generator and Exciter Troubles.

Assuming a given current flow through a set of field coils connected in series and subjected to a given voltage, if the coils be reconnected to give two series paths in parallel and the same voltage be applied to them, the current will be four times its former value because the resistance is but ¼ as great. As the total current must divide between two paths, however, the current per coil will be only twice the former value and neglecting magnetic permeability, the magnetic flux produced will be twice that of the original series connection. Assuming, however, that the original series of coils is part of a circuit, the current of which is maintained constant, if the coils be reconnected two-path multiple-series, as before, each coil will get but half as much current as it got with all coils connected in series and the resulting magnetic flux will be correspondingly reduced. On those alternating current generators in which compounding is effected by rectifying the current and sending the rectified current through series coils wound on all spools in addition to the regular fine wire coils provided for separate excitation, the rectifier and the series coils dependent upon it are of the nature of a constant-current device and the amount of current that traverses them, depends largely upon the resistance of the external circuit.

Therefore for a given current in the external circuit, the magnetizing effect of the series coils will be greater when all coils are in series and are getting the total current, than when the coils are in two-path multiple-series and each coil is getting but half of the total current. An inspector was called to ascertain why one of these compounded alternators failed to deliver rated over-compound at full load current. It developed that the machine had been bought second-hand and that the operator had had it converted from 1,150 volts 80 amperes rating to 2,300 volts 40 amperes rating. This had been accomplished by making the necessary changes in the armature coil connections. As the workman had no instructions in regard to the field connections, he did not change them from multiple-series, which was the normal connection for the 1,150 volt machine, to the straight series, or the normal connection for 2,300

volt machines. The result was that owing to the fact that doubling the voltage rating automatically halved the permissible current rating, with the series fields in multiple-series, each coil was getting but half of the current that it should have gotten.

In other words, with the original 1,150 volt x 80 ampere rating and with the coils in multiple-series, each coil got 40 amperes. With the 2,300 volt rating, the current rating was 40 amperes and each coil should have gotten all of it, but with the coils in multiple-series, each got but 20 amperes. Upon changing the coil connections to straight series, the over-compound was corrected.

It is interesting to note that if the change had been from 2,300 volts to 1,150 volts instead of from 1,150 volts to 2,300 volts, it would have been necessary to go from the straight-series connection to the multiple-series connection in order to give the series windings sufficient capacity for the increased current. Failure to make such a change probably would have resulted in injury to the series coils as each might have been called upon to carry full load current of 80 amperes. Even with direct current machines, in changing the voltage, hence the current capacity of the armature, there is a tendency to overlook the demands of the series field windings for any change in the connections.

Brushes Off Neutral.

When a commutating pole generator is to operate alone, it is not necessary in some cases, that the brushes be on the exact electrical neutrals. Good commutation is then the limiting condition and this may obtain anywhere within a brush shift of several bars. It might be noted, however, that commutation apparently good as far as visible sparking is concerned, may be really unsatisfactory on account of invisible sparking which gradually pits the brush contact surfaces. If the brush contact surfaces evidence such pitting, the commutation should be improved, if possible, irrespective of whether the machine is to operate alone or in parallel with another machine. In the latter case it is essential that the brushes of all studs be on their respective electrical neutrals and unless the mechanical appointments of the brush rigging are very exact, it will not suffice to adjust one set of brushes carefully on neutral and assume that the brushes of the other studs are also, it may be necessary to locate the brushes of each stud by means of the milli-voltmeter test. This having been done, it may be fairly assumed that the compounding characteristics of two similar machines, as affected by both the series windings and the commutating pole windings, will be satisfactory for parallel operation provided all of the more ordinary conditions of parallel operation have been observed.

In one case an inspector was called several hundred miles to find out why two machines installed by an operator could not be thrown together without blowing the breakers between them, although either of them would operate alone from no load to 1½ load without a sign of a spark. Careful adjustment of all brushes to their respective neutrals and corresponding modification of the series field shunts, effected satisfactory parallel operation.

Generator Over-Compounded.

On commutating pole motors the electrical neutrals on which the brushes will operate sparkless for both directions of rotation, are obtained by so locating the brushes, by trial, that the armature speed is the same in both directions. Under this condition commutation will be satisfactory. To determine the neutrals accurately and with reasonable expenditure of time and labor, a tachometer is necessary. Except in train lighting, generators are seldom required to operate alternately in one direction and then in the other and unless the machine must parallel with another machine it is not essential that all brushes be on their exact electrical neutrals. This is because good commutation may be obtainable throughout a reasonable margin of variation in the position of the brushes and it is often exceedingly convenient to refine the compounding by means of a slight brush shift instead of by means of a series field shunt adjustment.

A commutating pole generator which had been operating sparklessly for several months in a temporary building, was moved to its permanent location in which it was necessary that the armature rotate in the opposite direction. The field connections had been properly reversed to suit the new condition, but upon trying to load the machine. the brushes sparked and the over-compound exceeded the amount desired. The operator hesitated to shift the brushes from what he had every reason to believe was their electrical neutral, but a milli-voltmeter test showed that the brushes really were not on their electrical neutrals. On moving them to that position sparking ceased and it was noted that the over-compound was a great deal less. Upon shifting them a little beyond neutral in the direction of rotation, the over-compound was reduced to the desired value and without introducing a sign of any sparking.

It developed that in the original installing of the machine, the compounding had been refined by means of a slight forward brush shift which became a backward shift with the reversed rotation. In order to get the same degree of compound in the reversed direction it was necessary to get the brushes into the same relative position and this the forward shift effected.

Exciter Belt Slipped.

Where a generator is separately excited its "no-load" voltage will vary directly and proportionately with the armature speed. With a load, however, armature reaction may interfere with the proportionality. Where a generator excites its own field, given speed variation will produce more than directly proportioned voltage variation because the voltage increases, for example, not only on account of the increased speed, but on account of the increased voltage thereby applied to the field circuit. Also, armature reaction may have its effect in this case. Furthermore, on compound wound machines the proportionality will be modified by the variation of load current through the series coils.

To illustrate this, an operator installed a new compound-wound exciter to operate in parallel with an existing one. On trying to parallel them, there was trouble with the load trying to shift from the new machine to the old one. An electrician determined that this was due to different compounding-characteristics incident to different brush shifts. This did not prevent their operating satisfactorily alone, but did prevent their paralleling successfully. He adjusted the brushes and shunts of each machine until their characteristics were similar and left them operating satisfactorily either alone or together.

A few weeks later he was called to account for what the operator called "the same action." The inspector again checked the brush positions and the compounding and found one machine all right. It was impracticable to get more than half load onto the other machine on account of its belt slipping. The newer belt had stretched since the first series of adjustments and this was what was causing all of the trouble. On tightening the belt, both single and parallel operations became normal.

Installation, Operation and Maintenance

This section is devoted to practical suggestions, experience and data, and is open to all readers who have something to say on every day work and trouble in the plant or sub-station, on the line, in the factory, mill or elsewhere.

Wrought Iron Pipe Switchboard Supports.

Supports of wrought iron pipe for electrical wiring and switchboards have become very popular because of the flexibility and economy that result from the use of the tubing. Switchboard and accessories manufacturers carry very complete lines of fittings to adapt iron pipe to electrical construction services, and it is believed that it is usually economical, where it is possible to do so, to buy the fittings for the construction of pipe structures from these manufacturers. It frequently occurs, however, that circumstances are such that it is impossible to purchase these regularly manufactured appliances. Then the constructor must make them for himself, and it is the intent of this article to describe how some of the fittings that are most frequently used can be made from materials that are usually available.

In Fig. 1 the top view shows a typical switchboard panel, which is supported about 6 feet from the wall with braces of wrought iron pipe. The different fittings attached to the pipe illustrated are described in detail in the following paragraphs, but this assembly drawing indicates how they are put together in the completed installation. The wall forging *A* which provides a means of attachment for the pipe braces at the wall, is merely a piece of strap iron bent into an L shape. It should not be thinner than $\frac{1}{2}$ inch and should be at least $1\frac{1}{4}$ inches wide. The location of the bolt holes will be determined by local conditions, hence it is impossible to specify them here. In Fig. 1 the forging is held to the wall by two lag screws which turn into wooden plugs set in round holes in the wall. For such service metal plugs are preferable to wood, in that the wood will probably dry out and loosen in the hole. A satisfactory lead plug can be made by using a lead pipe of suitable diameter, driving the pipe into the hole, and then turning the lag screw into the hole in the pipe. This will expand it into the cavities in the side of the hole and secure both the plug and the lag screw very firmly.

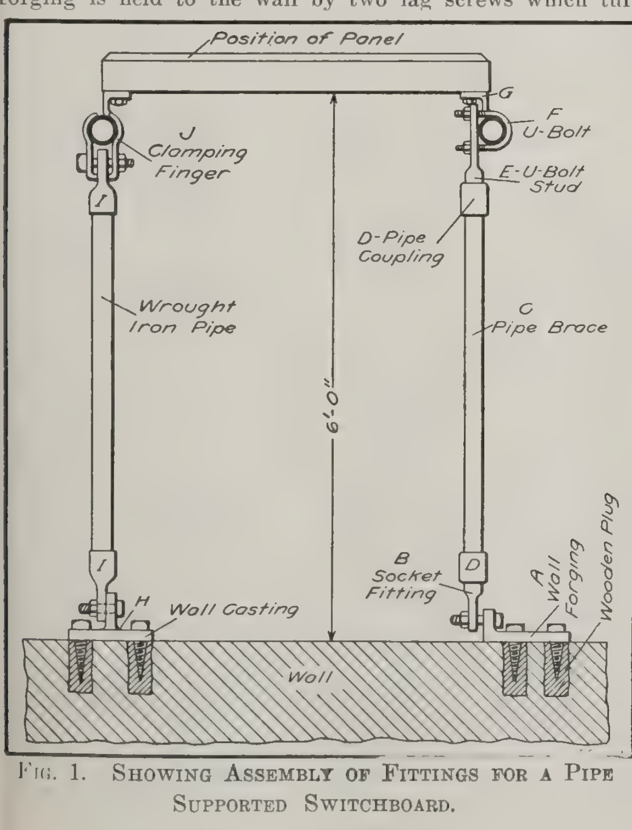


FIG. 1. SHOWING ASSEMBLY OF FITTINGS FOR A PIPE SUPPORTED SWITCHBOARD.

At the left side of Fig. 1 is shown a wall casting which can be made from a simple pattern and which of course is cheaper than the corresponding forging, if there are many such supports to be placed. The forging is the cheaper where only a few supports are required.

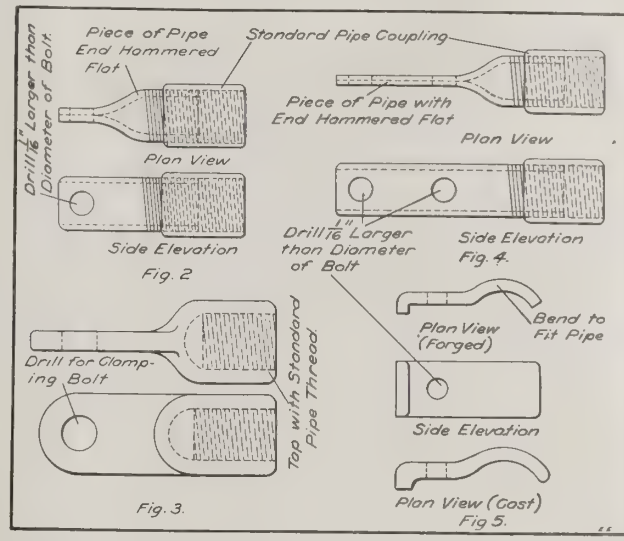


FIG. 2. SOCKET FITTING OF PIPE. FIG. 3. CAST SOCKET FITTING. FIG. 4. U-BOLT STUD OF PIPE. FIG. 5. WROUGHT IRON CLAMPING FINGER.

The socket at *B* Fig. 1, detailed in Fig. 2, is a piece that provides for the attachment of the pipe brace *C* to the wall flange. It consists merely of a piece of pipe $\frac{3}{4}$ inch or 1 inch in diameter for light work, and $1\frac{1}{4}$ inch for heavy work, threaded on one end and flattened down at the other. A hole is drilled through the flattened end. The threaded end of the piece turns into the coupling and the hole in the other end engages with a bolt set in the wall forging. It is possible to do away with the socket fitting by flattening and drilling a hole into one end of the pipe brace *C*, but where this is done the piece *C* will be a long length and awkward to handle. It is usually more convenient to make up each of the small fittings complete in itself and so arrange them that they can be screwed on long lengths of pipe. This procedure eliminates the necessity of handling long pieces of pipe in the shop where the fittings are made, and it also renders it possible to construct all of the small fittings of practically uniform size, which is an advantage. Where a casting is used to replace the socket fitting, it may take the form shown at *I* Fig. 1, and detailed in Fig. 3. Castings of this type can frequently

be secured from awning makers. They use these socket fittings to form hinges of awnings.

At *E* and *F*, Fig. 1, is shown the U-bolt arrangement whereby the pipe brace attaches to the vertical 1¼-inch pipes which support the switchboard panel. The U-bolt stud is detailed in Fig. 4, and is made by flattening down one end of a length of pipe and threading the other. Two holes are bored in the flattened end for the accommodation of the U-bolt. The U-bolt is detailed in Fig. 6, *B*. U-bolts can be bent cold from ⅜-inch iron rod. The two ends should be threaded before the bending is done. To insure correct curvature of a bend it can be formed around a piece of pipe of the diameter of that about which it is to clamp.

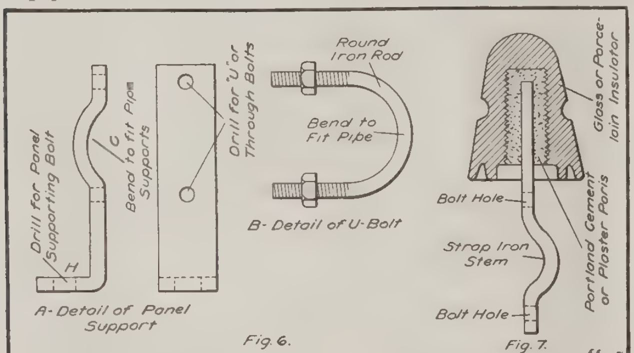


FIG. 6. PANEL SUPPORT AND U-BOLT. FIG. 7. STRAP IRON STEM CONNECTED IN INSULATOR.

Another method of attaching the vertical panel supporting pipes to the pipe braces is shown at *I* and *J* in Fig. 1. With this arrangement, two clamping fingers, which may be either wrought or cast, Fig. 5, are wedged against the socket fitting and the pipe with a through bolt. For general service the U-bolt method shown at *F*, Fig. 1, is preferable to that shown at *J*. For attaching the switchboard panels to the vertical 1¼-inch pipes a forging like that shown at *A*, Fig. 6, can be used. One of these forgings is required at each point where the switchboard panel is drilled for a supporting bolt. The panel supporting bolt passes through the hole *H*, and the curved portion *C* should fit around the 1¼-inch pipe. A U-bolt binds the forging to the pipe.

The most frequently used fittings have now been described. However, by exercising some ingenuity, a construction man can make for himself many others that will save time and money. For instance, he can arrange porcelain or glass petticoat insulators for mounting on wrought iron pipe supports by fastening into them suitable strap iron stems, shown in Fig. 7. The stems can be held in the holes in the insulators with Portland cement or with plaster of paris. The ends of the stems that extend beyond the insulator can be curved to fit around the pipe just as the fitting *A* in Fig. 6 is curved, and then they can be held to the pipe support with U-bolts.

M. R. Schock.

Determining Power Taken by Machines.

The electric motor is fast superseding other forms of motive power not only because it can generally accomplish more work for less cost but because it is so very much more flexible, reliable and safe. In order that the full advantages of electric drive may be obtained, it is not enough to simply substitute an electric motor for any other type of motive power for a careful study of the conditions must be made.

As the value of test results are dependent upon their accuracy, which in turn depends upon the accuracy and reliability of the measuring instruments used and upon the human element, a few remarks concerning measuring instruments and the precautions that should be taken in their use may prove serviceable.

There are three types of measuring instruments in common use, namely, the induction, moving coil and magnetic vane types. The former will operate on alternating current only, the latter on both alternating and direct current. When choosing a meter, the meter capacity should be such that the deflection is between 25 and 80 per cent of full scale, thereby securing minimum deflection and observation errors. In the induction type of meter, where the deflection is proportional to the square of the current, the errors on the first 20 per cent of the scale will be quite high, while with the magnetic vane and moving coil types, the deflection and observation errors will be quite appreciable at both ends of the scale. Stray magnetic fields must be guarded against, especially when using instruments of the magnetic vane and moving coil types. Meters of the induction type are almost immune from stray field effects. The heavier the current the more care should be exercised. When portable instruments are used the meters should never be nearer together than six inches. Several readings should always be taken with the instruments in different positions. Where rough handling is to be expected, and where the meters are to be subject to rough usage, induction meters prove the most satisfactory because they are exceedingly rugged. If current transformers are used the capacity should be chosen so that the current corresponds to from 50 to 125 per cent full load.

When using indicating instruments to obtain a true idea of the power required to operate a machine during the different cuts, etc., it is necessary to take readings at very frequent intervals. Two or three men are generally needed because, for reasons of accuracy, simultaneous readings of current, voltage, watts, etc., must be taken, and even then the results are not truly representative. After the test the data must be arranged.

The graphic recording meter offers a means of obtaining results, the accuracy of which are far beyond any that can be expected by the use of indicating meters. To be suitable for a large variety of work the rate of travel of both pen and paper should permit of adjustment. There are recording instruments on the market in which the clock has a speed of two, four, six and eight inches per hour, while gears are provided, by means of which a speed of twenty-four inches may be obtained. The pen also may be adjusted to require one to thirty seconds to travel across the entire scale. Such an instrument is, of course, applicable to a very wide range of work. For testing the power requirements of individual machines, the writer has found a fairly high paper speed, six or eight inches per hour, with a rather sensitive pen, the most suitable for average work, as by this means the current rush at the time of starting, or when throwing from notch to notch of the controller, or with sudden change of load, is clearly shown.

Sometimes it will be found most convenient, where several machines of very different characteristics must be tested without readjustments of the graphic meter, to adjust the meter for the average power requirements and determine the peak values of current, voltage and watts by the use of indicating instruments.

Personally I cannot speak too highly of the graphic meter for accurate work of the nature under discussion. It is the only meter that will record how much power is used, when it was used, and for how long. It gives the load factor, maximum demand and average load under working conditions, from which the power rates that should be charged may be determined, or the more economical operation of a plant accomplished. The meter the writer has in mind is operated by relays so that changing the sensitiveness of pen and paper does not affect the calibration of the instrument.

The investment in a graphic meter is rather high, as compared with a set of portable instruments, but on the other hand, if much work of this class is to be performed, the accuracy of results and the very considerable saving in labor will more than compensate for the high initial cost.

In recording test results, care should be taken to obtain (1) the type of machine under test, (2) the form of tool used, (3) the kind and quality of metal cut, and (4) the rate of removing the metal, of which (a) depth in inches per revolution, (b) cutting speed in feet per minute, (c) feed in inches per revolution and (d) the cubic feet per minute removed should also be recorded. When indicating instruments are used, it is well also to keep a record of (e) the number of cuts per hour, and (f) the duration of each cut, as these factors largely decide the rating of the motor, load factor of the machine or the efficiency of the man operating the machine.

Not knowing the reasons for making the tests, it is rather difficult to give a definite outline of the tests required. As the horsepower needed is determined by the rate of doing work, and the work done in cutting metal depends on the form of the tool used, the amount of metal removed in a given time and the quality of the metal, all should be varied over a wide range if complete data is required.

A considerable amount of literature dealing with the power reuirements of machine tools, the requisite characteristics of motors for the different machines, etc., will be found in the technical magazines and journals of the last three years. The Westinghouse and General Electric companies, and most of the large manufacturers of machine tools, have valuable data that may be had for the asking. The Electrical Solicitors Handbook, issued by the National Electric Light Association, also contains a large quantity of useful data on the power requirements of machine tools.

As neither the frequency of the supply circuit nor the speed of the motor is given, the no-load current of a 10 H. P., 220-volt induction motor can only be approximated. The no-load current varies over quite a wide range even with motors of the same class and type, but it should be safe to take it as being from 20 to 30 per cent full load current. The higher value should be taken when calculating the size of copper, whereas the lower value is the one to use when calculating the pull on relays for autostarter control, etc. I. L. Kentish-Rankin.

Boiler owners should provide every possible method of safeguarding human life and property by purchasing only such boilers as have been thoroughly inspected during course of construction, and by seeing that they are also inspected during their active life.

Operating Details of Internal Resistance Motor.

There are three general methods of bringing a motor from standstill to full speed. The first depends upon the time elapsed since the circuit was first closed. This time is controlled by means of an air or oil dash pot or some similar device. This starter will operate at the same rate regardless of the speed of the motor or the starting conditions. It is evident that this method is not always satisfactory; for under abnormal conditions the current would be excessive, causing a risk of injury to the motor and increasing the fire hazard.

A second method is to employ a set of relays so adjusted that each successive step is not made until the line current has dropped to a certain pre-determined value. This method is entirely successful but so complicated and expensive that the field is very limited.

In the third method the changes in current are determined by the speed at which the motor is operating. These changes are made gradually and automatically, thus bringing the motor smoothly from zero to full speed. This is the principle used in the internal starter motor, which the writer will discuss in what follows: This motor consists of a standard squirrel cage stator and a phase wound rotor and on the shaft with the rotor is a device for automatically changing the secondary resistance during starting. It employs the well-known fact that a loose pile of carbon discs or grains has a high resistance while the same under pressure has a comparatively low resistance. Each lead from a three-phase wound rotor is connected to a "pile" of carbon discs contained in an insulated iron tube and the opposite ends of the piles are all grounded, thus forming a Y connection in the secondary circuit, as shown in Fig. 2.

These tubes containing the carbon discs are mounted radially 120 degrees apart in a fly wheel. (More tubes can be inserted if necessary.) The spacing of the tubes is such as to give perfect balance to the rotor. The fly wheel is keyed to the shaft of the rotor and the frame covers both. The tubes are free to move radially through guides as shown in Fig. 2. In the rim of the fly wheel are three countersunk adjusting screws, one bearing on each pile by means of an insulated pressure plate. There is a strong spiral spring tending to retard the outward movement of the tubes due

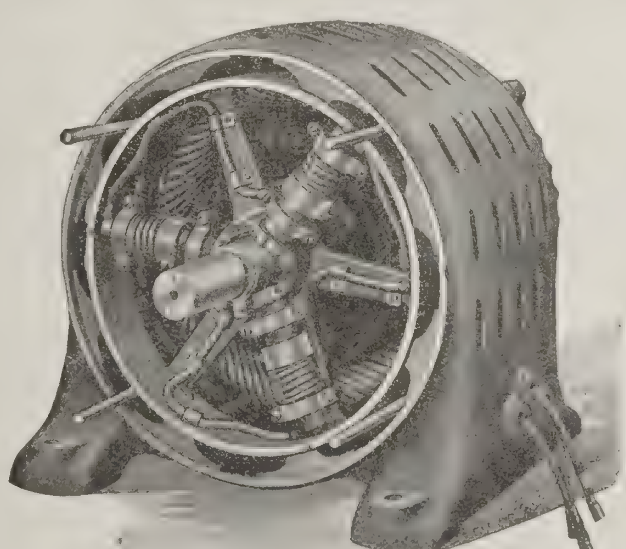


Fig. 1. Motor Assembled Showing Position of Resistance at Starting.

to centrifugal force as the speed of the rotor increases. As the tubes move outward the pressure is increased on the pile of carbon discs and the resistance is decreased. This pressure can be so finely adjusted that any desired resistance can be obtained during acceleration. If the pressure can be adjusted to give any desired change in resistance it follows that the starting current and torque can be varied to suit the conditions at hand. The total motion of each pile does not exceed one-sixteenth of an inch, so it can be said that the starter is practically without moving parts.

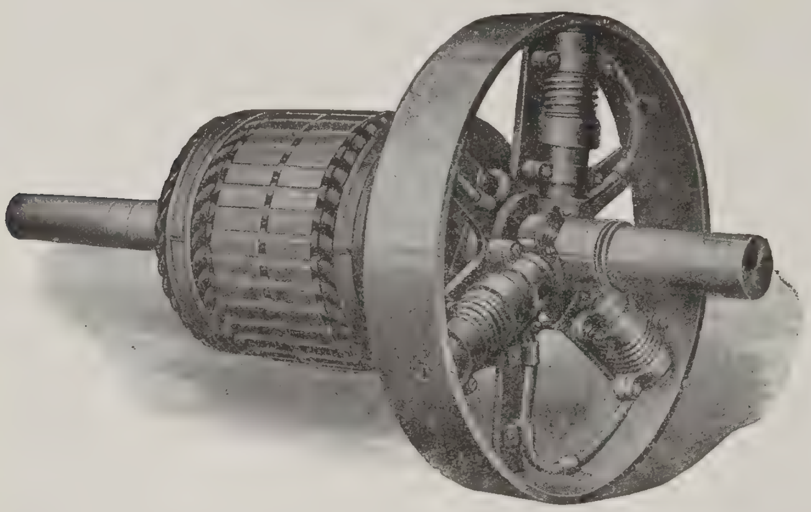


Fig. 2. Armature and Device for Changing Secondary Resistance Changing Device.

The performance of this motor is no different from that of the ordinary phase wound motor. The same conditions would be brought about by the expert cutting out a resistance of many steps, as the rotor speed increases. Equal efficiency would be obtained by both methods since the resistance of the pile is no greater than that of brushes, collector rings, and connections to an external resistance. The slip is not over 5 per cent in the continuous duty type and not over 7½ per cent in the intermittent type.

Referring to the curve, Fig. 3, where the current and torque are plotted against time it will be seen that the motor reaches its normal speed in about twelve seconds. When the line switch is closed the current as shown is about 220 per cent normal and the torque 195 per cent, both gradually rising until about the sixth second and then gradually dropping until normal conditions are assumed.

This type of motor is more simple to install and operate than the ordinary squirrel cage motor, for all that is needed is a line switch and the motor can be installed at any distant point and no starting circuit or secondary wiring is needed. A no-voltage release can be attached to most of the starters but the motor must be manually started when the voltage is again applied to the line, but with this unit the motor starts up again normally when voltage is again applied to the line.

There is no trouble from heating in the pile of carbon, for if any heat is produced it is quickly dissipated by the fan action of the tubes. After a fair test the temperature will not rise 10 or 15 degrees. If the load is excessive, before the stator would be damaged the pile would heat and expand, thus increasing the pressure and decreasing the resistance to such a point that the motor would start. This is quite the reverse of any other type of resistance for starters.

The motor is well adapted for customers obtaining power from a central station that has a very exacting clause in the contract governing the allowable current on starting. Some of the applications to which it is well adapted are elevators, ice-making machinery, pumps, wood-working machinery having high inertia and in fact any constant speed machinery having a high starting torque.

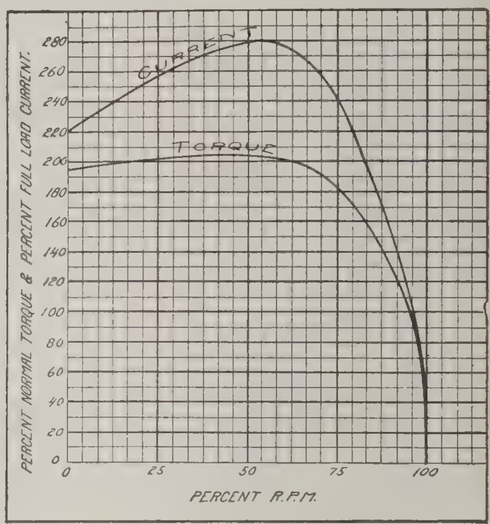


Fig. 3. Current and Torque Curves at Starting of Motor.

W. C. Du Vall, *Engineer Fairbanks-Morse and Co.*

Why Disconnecting Switches Open on Short Circuits.

Disconnecting switches are frequently thrown open when a short circuit occurs on the lines connected to them because of the magnetic reaction of the field generated by the current passing through the switch. During normal operation the current through the switch is so small relatively, that the magnetic field generated around the switch is of insufficient strength to make the switch open. However, at a time when an external wire is short circuited, the current through the switch may be increased to many times its normal value. It is then that the magnetic reactions generated by this current are sufficient to throw the switch open, as will be explained in the following paragraphs.

A magnetic field of circular lines of force establishes around every conductor through which an electric current is flowing. In Fig. 1 is indicated in a rough way how these circular lines of force establish around the ring shaped conductor *A B C D*. Now, due to the interaction of these

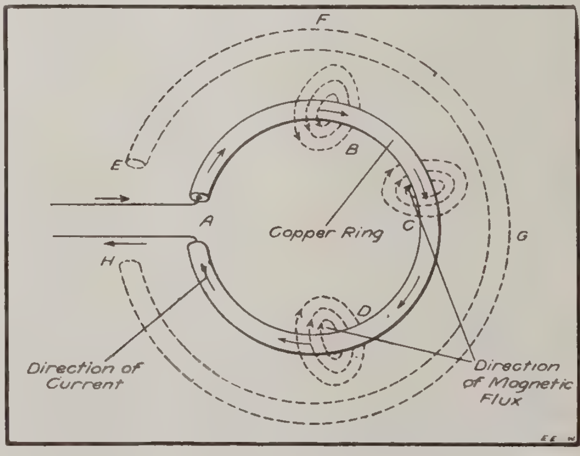


Fig. 1. Magnetic Field About a Circular Conductor.

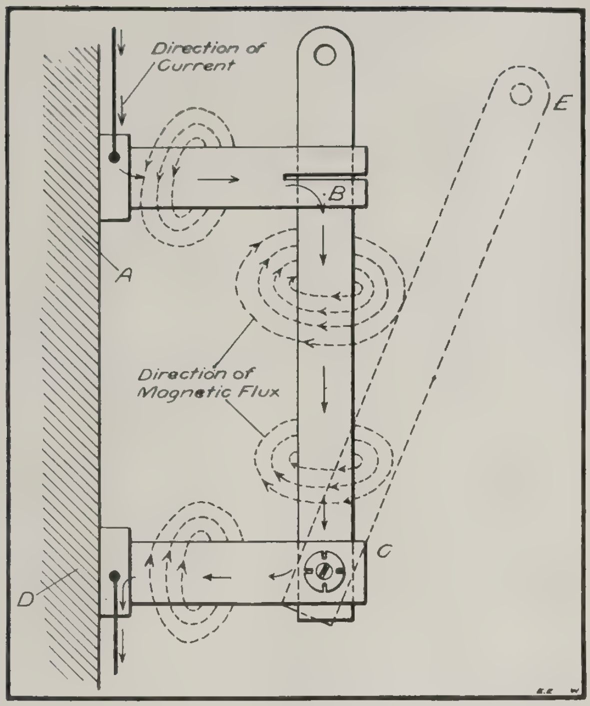


Fig. 2. Magnetic Field About a Disconnecting Switch.

circular lines of force there is always a longitudinal tension along a conductor carrying current, and there is also a transverse compression, that is, the lines of force act like taut rubber bands. They tend to shorten themselves in the direction of their lengths, and furthermore they tend to crowd away longitudinally adjacent lines. Because of this phenomenon, every conductor which has a shape approximating a ring, tends to enlarge so as to enclose a maximum number of lines of force. For example, the tendency of the conductor *A B C D* of Fig. 1 is to enlarge into a shape *E F G H* so as to enclose more lines.

Obviously such an enlargement is impossible under ordinary conditions because the tensile strength of the metal of the conductor is sufficient to prevent such enlargement. If, however, we now consider a disconnecting switch as shown in Fig. 2, it is evident that when the blade is thrown from the position *BC* toward the position *EC,* that the conducting portion *A B C D* will enclose a greater field. The phenomenon illustrated in Fig. 2 is precisely what occurs when a short circuit current throws open a disconnecting switch. A short-circuit current, which is many times normal value, establishes about the conducting part of the switch *A B C D,* circular fields of force, and it is due to the interaction of these, that is, to the fact that the tendency of every conductor carrying current is to enclose a maximum number of lines of force, that the switch is thrown open to a position, for instance, *EC*.

To prevent the accidental opening of disconnecting switches it is modern practice to supply them with latches which must be released by the attendant before the switch can be opened. A disconnecting switch with one of these latching arrangements is illustrated in Fig. 3.

The distortion of bus structures that sometimes occurs when a line is short circuited is due to magnetic actions similar to those that occur when a disconnecting switch is thrown open. As to the methods of correcting the difficulties caused by these excessive magnetic interactions, it is evident that all of them are due primarily to excessive currents. It follows then that any expedient which will pre-

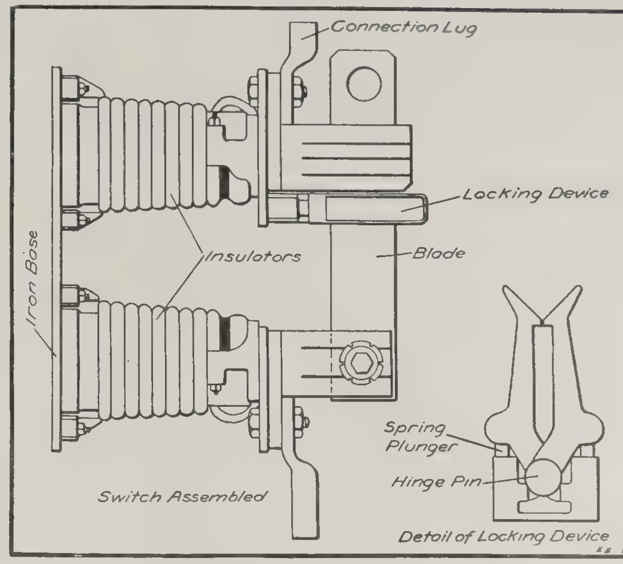


Fig. 3. Disconnecting Switch Showing Catch to Prevent Opening.

vent the possibility of excessive currents through the bus structures in disconnecting switches will prevent their accidental distortion. The current through the lines and bus structures of a central station can be limited by inserting reactance coils, or as they are called commercially "current limiting reactances" at proper locations in the circuits. Inasmuch as the average drop across these reactances is largely inductive, little real power is expended when current passes through them. At the same time, the reactances will limit the current that flows when a short circuit occurs, and thus protect all of the central station apparatus.

Terrell Croft.

Extension Phone Service.

When a telephone is installed in a residence, the question always arises, where shall it be put for maximum convenience?

To this end some people put the phone on a stairway landing with the idea that then one will have to go only half way up stairs to reach it. The fact is there is no saving in steps by this, for one must always go half way up or down, hence the total steps will be the same as if it were on either floor.

To obviate this, have your phone equipped with a cord long enough to reach to the top or bottom of the stairway from the landing, having the bell box placed half way up. By this means the housewife can keep the phone down stairs until she is ready to go up, when she can take the phone with her. When she finishes her work upstairs and comes down, she again takes the phone with her.

This arrangement serves the purpose of an extension phone upstairs, saving an expense of fifty cents a month for the extra instrument. Usually the company makes no objection to this arrangement if the subscriber pays for the extra long cord.

Prof. G. B. McHair, Kansas State College.

To stick paper on hot tin, use a fairly thin glue made by soaking sheet glue in warm water until dissolved and then adding one-fourth as much glucose, by volume, as glue. This paste applied either hot or cold with a brush will stick tight, and will not affect ink on the labels, no matter how hot the tin may be—up to the burning point.

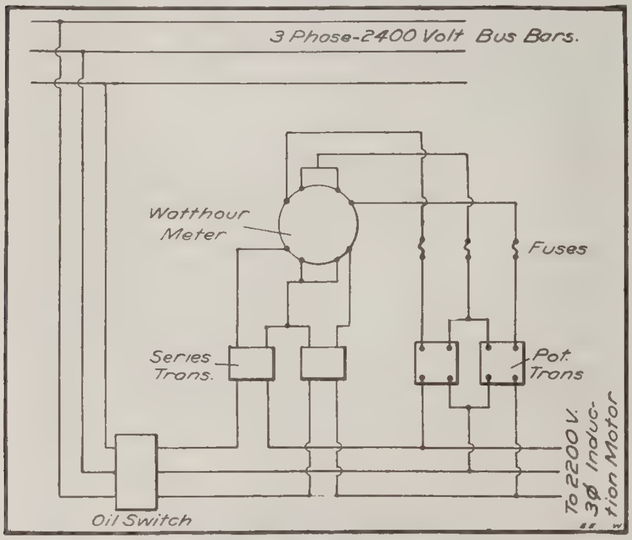
Questions and Answers from Readers

Readers are invited to make liberal use of this department for discussing questions, obtaining information, opinions or experiences from other readers. Discussions and criticisms on answers to questions are solicited. However, editors are not responsible for correctness of statements of opinion or fact in discussions. All published answers and discussions are paid for.

Trouble With Watthour-Meter on Arc and Induction Motor Circuits. Ques. No. 499.

Editor Electrical Engineering:

(516) The comment by Mr. F. J. Rankin on page113 of the March issue of Electrical Engineering has not helped me to locate the trouble referred to in my original question. I have not been able as yet to find it. The accompanying sketch shows the connections for the meter at the back of the switchboard. It registers about 2.0 Kw.-Hrs. during 20



Connections for Watt-Hour Meter Giving Trouble.

minutes when the current per phase is 10 amperes, due to the induction motor load. According to my calculation it should register as follows:

$(\sqrt{3} \times 10 \times 0.8 \times 2400) \div 1000 \times 0.33 = 11.07$ Kw.-Hrs.

When the street lamps are on at the same time the motor is in service, the meter runs backward. V. K. Stanley.

Grounding of Conduit.

Editor Electrical Engineering:

(517) The 1913 National Electric Code, Section 28, rule F, reads in part as follows: "When short sections of conduit (or pipe of equivalent strength) are used for the protection of exposed wiring on side walls, and such conduit or pipe and wiring is installed as required by No. 26-E, the conduit or pipe need not be grounded."

If conduit need not be grounded in this case, why should short sections of conduit be grounded anywhere? What would you call short sections? S. P. H.

Selection of Brushes for Generator.

Editor Electrical Engineering:

(518) The writer would like to know if it would be practical to slot the commutator of a 3-wire, 250 volt, 150 Kw. D. C. generator, running at 225 rpm. When the brushes that came with the generator are used, the mica is worn down slower than the copper and poor brush contact the result. I have used soft carbon, hard carbon and graphite brushes with best results from the hard carbon. Advice on this matter will be appreciated. L. J. C.

Operation of Rotary Converter.

Editor Electrical Engineering:

(519) The writer has heard it said that a rotary converter should always be operated as near 100 per cent power factor as possible. Is this to keep down the heating or increase the efficiency of the unit or both? Please explain and show how to adjust the machine so as to get 100 per cent power factor operation. W. E. B.

Grounding 3-Wire 110—220 Volt System.

Editor Electrical Engineering:

(520) When a 3-wire, 110—220 volt system is grounded, is it not more dangerous to life when making the 220 volt connections than when the system is not grounded, especially in steel buildings with concrete floors and where workmen are liable to come into contact with the metal and exposed terminals? H. R. S.

Changes in 440 Volt Induction Motor for Operation on 220 Volts. Ans. Ques. No. 493.

Editor Electrical Engineering:

In all probability the 440 volt motor is series connected so the change to 220 volts will be simple. If it is a 4 pole motor, Fig. 1 shows the way it is probably connected. The segment 1—2 represents one group of coils forming a pole in one phase which in this case is 5 coils. It will be seen that in this connection all the coil groups in phase *A* are connected in series. The same is true of phases *B* and *C*. To operate on half voltage it is necessary to have half as many coils in series. This will give two groups in series in each phase and two of these series circuits in parallel. Fig. 2 shows the reconnection for 220 volts. If the motor is 6 or 8 pole the same scheme can be followed. It will be noticed that the connections between coils in a group have not been changed but only the connections between some of the groups.

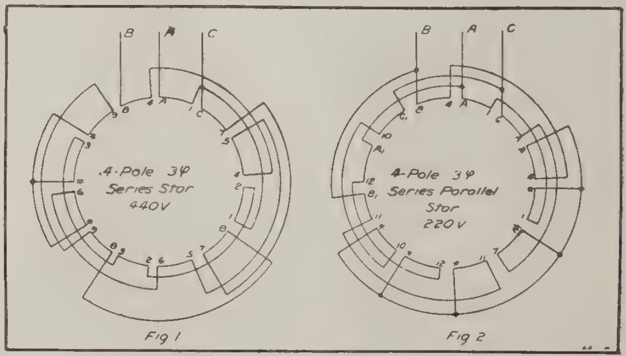


Fig. 1. Probable Connection of Windings for 440 Volts and Fig. 2. Reconnection for 220 Volts.

Features of No-Voltage Release for Motors. Ans. Ques. No. 495.

An overload release is used for the same purpose as a fuse, that is to protect the motor from injury by overheating in case too much current flows. When the current exceeds the value for which the overload trip is set, it cuts the current off the motor. Ordinarily the motor cannot be started again till the operator resets the trip. It may be used on all direct and alternating current motors.

A no-voltage release is used for the reason that without it if power fails and the motor stops, and power then comes on the line again, the motor is standing still and is connected directly to the line without starting resistance.

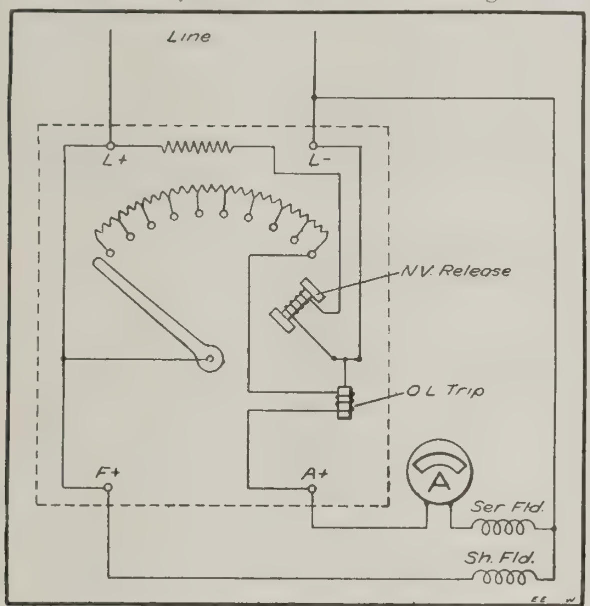


Fig. 1. No-Voltage Release for D. C. Motor Starter.

When the no-voltage release is used and the voltage of the line fails, the no-voltage release cuts the motor off the line and prevents injury due to a heavy rush of current that would occur if power came on with no starting resistance in the motor circuit. A no voltage release should be used on all motors that are not started by throwing them directly on the line without resistance or a compensator.

There are many mechanical arrangements of these releases. On an ordinary face place starter for D. C. motors, the handle is held in the "on" position by a magnet. Fig. 1 shows one connection for this magnet. In case voltage fails the magnet is de-energized and a spring returns the handle to the "off" position. If too much current flows to the motor it will energize the coil of the overload trip strong enough to pull the plunger and break the circuit to the no-voltage release magnet, allowing the handle to fly back. A similarly device is used on hand operated A. C. starters. The handle is returned to the "off" position by a spring and held in the "on" position by a magnet or latch. This latch is tripped in the same way as above. R. H. Willard.

Steam Consumption of an Engine. Ans. Ques. No. 497.

It is customary to calculate the steam consumption of a steam engine from its average indicator card. This is called the indicated steam consumption and is somewhat smaller than the actual consumption, which must be measured if desired accurately or approximated by knowing the usual excess of steam used over that accounted for by the card for the given design of engine.

H. E. Weightman.

Electron Theory of Magnetism. Ans. Ques. No. 496.

Editor Electrical Engineering:

The electron theory gives us the deepest insight into the relation of matter and electrical energy. It is based upon a series of classical experiments and mathematical deductions briefly outlined in the following paragraphs.

It has been shown mathematically that an electrified body when moving at a high speed suffers an increase of mass due to the reaction of the electric field around it. When an electric field is constantly shifted it reacts to such a change, similarly as mass acts to a change of position by giving the reaction known as inertia. An electric charge at rest gives us the electrostatic field, a charge in steady motion gives us the magnetic field and a charge accelerated gives rise to electric radiation (wireless waves) and light. The fundamental conceptions are simple but become very much involved when applied to actual conditions.

From the electrical conductivity of gases we find matter or ions carrying charges from one terminal to another in a vacuum tube. In a cathode ray tube the negative charges, on account of the extreme rarification, have a very high velocity. These corpuscles each carrying the same quantity of electricity irrespective of the gas used are electrons. Prof. J. J. Thomson experimentally determined the charge and the mass of these electrons. He attributed the mass of the electron to be due partly to the charge moving at a high velocity and partly to the matter holding the charge. Kaufman then determined the ratio of the charge to the mass (e/m) for the beta rays in radium. The beta rays are cathode rays of different velocities. Thomson then showed from these experiments mathematically that the charge which was measured on the electron would account for all its mass or matter. In other words, we no longer have matter but just an electrical charge.

The nature of this electron or negative charge is conceived as being spherical and granular. The nature of the positive charge is at present a basis of speculation. It is variously assumed that these electrons revolve around a positive charge as the planets and satelites do around the sun or that they have their motion in a field of uniform positive electrification. In a hydrogen atom there are about 770 electrons while in the heavy mercury atom there are more than 150,000 electrons. These are, however, not crowded but have plenty of room. If the earth were to represent an electron, an atom would occupy a sphere whose diameter would be about 720,000,000 miles.

This advance in science not only shows that the supposed most simple chemical conception of matter, the atom, is infinitely complex. It also forms a basis for the explanation of radioactivity and the slow decomposition of the heavier staple elements into lighter ones in systems where the electrons are unbalanced. When a salt is dissociated in a liquid and forms an electrolyte, the component elements gain or lose an electron, thereby becoming charged negatively or positively respectively. When radium breaks down into helium and lead, the amount of heat evolved is 4,000,000 times larger than the most exothermic chemical reaction of hydrogen and oxygen. There is thus an indication that these electrons possess in connection with the positive charges an enormous store of energy. The key to this store-house at present is not known.

For detailed information of electrons the treatise of Sir Oliver Lodge's Electrons is simple and clear. The Elec-

trical Nature of Matter and Radioactivity by H. C. Jones is also free from higher mathematical interpretations, and gives a very clear insight into this new field of science. The Electrical Conductivity of Gases by J. J. Thomson is best suited for parties wishing to go deeper into the subject.

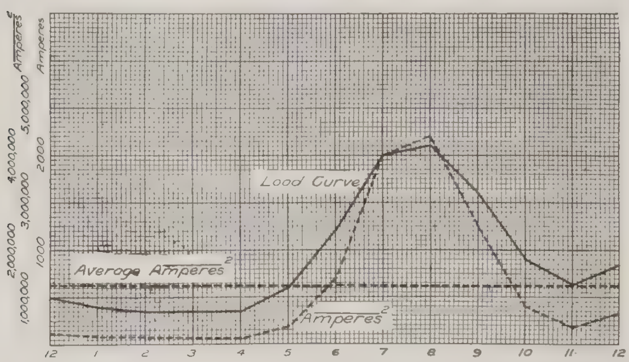
F. W. Lieberknecht.

Calculation of Line Loss With Fluctuating Load. Ans. Ques. No. 498.

Editor Electrical Engineering:

Since the power loss is (I^2 R) the average current of a fluctuating load will not give a correct value for line loss.

Take ordinates on the load curve fairly close together and square them, plotting the results as a curve of (I^2) instead of (I) as the load curve is plotted. Get the average height of this curve either by measuring the area and dividing by the length along the axis or by any other means.



CURVES SHOWING CALCULATION OF AVERAGE AMPERES FOR FLUCTUATING LOAD.

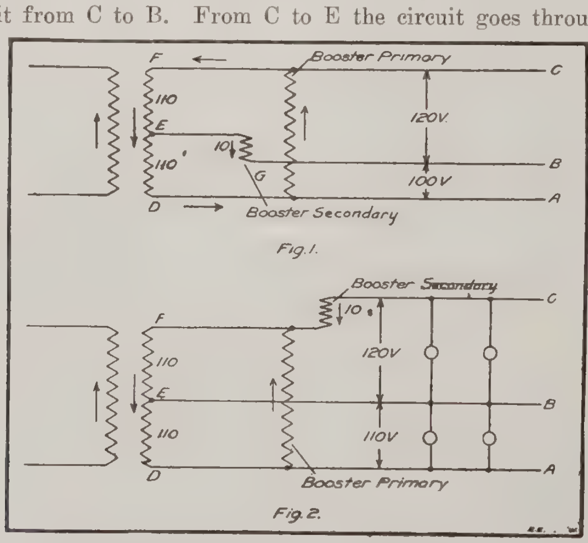
When this average (I^2) is found, multiply it by the line resistance to get the (I^2R) loss in the line. In the curve shown the average (I^2) is 1,250,000 amps². If the total line resistance is 0.1 ohm, the line loss is $I^2R = 125,000$ watts or 125 KW.

Peculiar Action of Booster. Ans. Ques. No. 500.

The diagrams shown here will help to explain the action of a booster in the neutral. Although the voltage is alternating, we can give it a definite direction since at any instant the voltages in different parts of the circuit have a definite directional relation to each other. The arrows show the directions of the different voltages at a certain instant. The direction of the voltage in the secondary of a transformer is opposite to that in the primary. Trace the circuit from C to B. From C to E the circuit goes through half the main transformer in the same direction as the arrow. This gives 110 volts from C to E. From E to B the circuit goes through the booster in the direction of the arrow. This adds 10 volts, making the voltage from C to B 110 + 10 = 120 volts. Going from B to A the circuit goes through the booster in the opposite direction to the arrow. This gives 10 volts. From E to A through the main transformer with the arrow gives 110 volts. This makes the voltage from B to A 110 — 10 = 100 volts. Thus it will be seen that the booster did not raise the voltage between A and C which is still 220 volts, but it unbalanced the voltage between outside wires and neutral.

Take the case with the booster in one outside line Fig. 2. Trace the circuit from C to B. From C to F through the booster with the arrow gives 10 volts, F to B through half the transformer 110 volts. These add so that the voltage from C to B is 110 + 10 = 120 volts. Voltage from B to A is that of half the main transformer or 110 volts.

R. H. Willard.



FIGS. 1 AND 2. CONNECTIONS SHOWING ACTION OF BOOSTER.

Line Loss With Fluctuating Load. Ans. Ques No. 498.

Editor Electrical Engineering:

In answer to question 498, C. A. H. is correct. The average value of the fluctuating current squared times R will not give the true line loss.

The correct method of figuring this loss is to obtain a chart for a given cycle of operation by means of a graphic ammeter. Taking the chart for one cycle of operation, divide the base line into a large number of equal parts. Erect perpendiculars at each division equal to the current at this point squared, then take the average value of this curve of squared current values and multiply by R. This gives the true value of the loss.

A simple illustration will serve to show the error of C. A. H.'s method. Let the current vary in a straight line relation from 0 to 10 amperes, the average value will be 5 amperes and this squared times R, equals 25 R. If now we take the curve of squared values we have a parabolic curve, with current voltages from zero to 100 and an average value of 33 1/3 amperes, the loss being 33 1/3 R.

Eric W. Luster.

Calculation of Line Loss With Fluctuating Load. Ans. Ques. No. 498.

Editor Electrical Engineering:

The line loss at any instant for a direct-current line, is expressed by RI^2 where R denotes the resistance of the line, in ohms, and I the value in amperes, of the current in the line at the given instant. The resistance of the line may be considered as constant, being true so long as its temperature remains constant.

If the current in the line varies from one instant to another, the line loss, expressed by RI^2, varies also. Since the line loss varies as the *square* of the current, if the current is at any instant double its value at some other instant, the line loss is four times as great at the instant the line loss is double, as at the other instant. The average line loss must therefore depend upon the average "square" of the current instead of upon the average of the current.

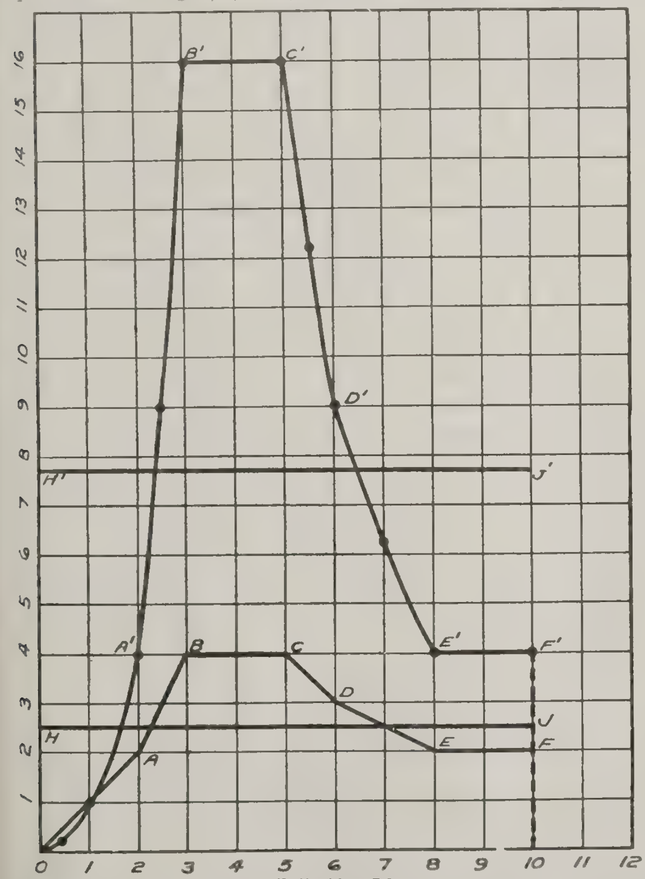
The *average* line loss may be better understood by assuming certain values and plotting them in the form of curves. Let it be assumed for example, that the resistance of a line is 5 ohms; that the current at any instant is zero;

and that from this initial instant the current changes uniformly from 0 to 2 amperes during 2 hours; during the next hour the current changes uniformly from 2 amperes to 4 amperes; during the next 2 hours it continues constant at 4 amperes; during the next hour it decreases uniformly to 2 amperes, and finally remains constant at 2 amperes during the next 2 hours.

The problem resolves itself into finding the *average* line loss, in watts, and the total loss in watt hours, or in kilowatt hours. Figure 1 shows the given conditions and results plotted to scale. In the figure, time in hours is plotted horizontally, while amperes, and amperes squared are plotted vertically. *OABCDEF* denotes the current curve according to the conditions of variation given above. The value of the average current, is found by dividing the area between the line *OABCDEF* and the base line, by the value of the base line. Expressed in other words, it is the number of included squares divided by the length of the horizontal base line; which is 10 units long. The number of included squares is 25.5. The average current is therefore $(25.5) \div 10 = 2.55$ amperes. The line *HJ* is drawn to indicate the average current value.

Each instantaneous value of the current, may be squared, and another curve, $A^1B^1C^1D^1E^1F^1$ drawn to scale, that may be called a *"curve of squares"* may be found by dividing the area included between this curve and the base of 10 units, by the numerical value of the base. The area included by the curve of squares is about 77.1 squares; giving as an average square of current; $I^2 = 7.71$; which is indicated by the line H^1 J^1. This is equivalent to the statement that the area of the rectangle $(O\text{–}H^1\text{–}J^1\text{–}10)$ is the same as the area included by the curve of square and the base line.

It may be noted that the length of (*A*-2) is 2; the square of 2 being 4, ($A^{-1}2$) is drawn 4 units in length. The



CURVES OF FLUCTUATING CURRENT AND SQUARES OF SAME.

length of (*B*-3) is 4; the square of 4 being 16, (B^1-3) is drawn 16 units long. The same reasoning applies to all corresponding values of the two curves. At the instant the value of the line current is 1.0 amperes, since the square of 1 is 1, both curves pass through the same point. At instants when the value of the current is *less* than 1.0, the curve of squares falls below the current line (*OA*). While the line (*OA*) is a straight line, the line (OA^1) denoting the square of the instantaneous values, is a curved line.

The average of the square of the current values, (7.71) multiplied by the value of the resistance of the current, in this case 5, gives the average line loss in watts. In the given case then, the loss is $7.71 \times 5 = 38.55$ watts. Then 38.55 multiplied by the time, 10 hours gives the line loss as 385.5 watt-hours, which at a rate of 10 cents per kilowatt hour for power, costs 3.855 cents.

The square of the average current multiplied by the resistance gives a different value from that just obtained. Thus $2.55^2 \times 5 = 32.51$, an error of $(38.55 - 32.51)$ 6.04 watts or 60.4 watt-hours; or a negative error of about 15.6 per cent. Were the charge based on the square of the average current, it would be only 3.251 cents for the 10 hour period.

Prof. F. E. Austin.

Trouble With Watthour Meter Reading on Arc and Induction Motor Circuit. Ans. Ques. No. 499.

Editor Electrical Engineering:

Without a diagram of connections, it is impossible to tell just where the trouble is in the case referred to by V. K. S., when the wattmeter fails to register.

It appears that one of the leads going to part of the loa dis taken off the wrong side of the current transformer. By trying each load separately, the circuit that is producing negative registration can be found and the right connection made. It is quite likely that there is a mistake in the conection to the arc transformer; that it is connected to the phase that has two current transformers, and that noe side of the line is connected before and one after the current transformers.

J. G. Longfellow.

Trouble with Watthour Meter Reading. Ans. Ques. No. 499.

Editor Electrical Engineering:

In answer to question No. 499, it may be that the meter is not properly connected. The change in the action of the meter is probably due to change in power factor due to change in load. The transformers for the series lights operates at a low power factor. The addition of the motor load raises the power factor and probably the 30 horsepower, 220-volt motor brings the power factor up to about 50 per cent. The 50-horsepower, 2,200-volt motor might raise it above 50 per cent.

I would suggest that the meter connections be checked and the following test applied: Disconnect one of the potential leads and note the direction the meter runs. Replace and disconnect one potential lead of the remaining element and again note direction of rotation. With the 2,200-volt motor in circuit and fairly well loaded, the meter should run in the proper direction in both cases. If it reverses with one potential lead disconnected the potential circuit of the other element should be reversed.

With power factor of less than 50 per cent one element of polyphase wattmeter will tend to rotate backward and

one forward, however the one tending to rotate forward has the greater torque and the meter, when properly connected, will rotate forward as a whole no matter what the power factor.

It may be possible in the case mentioned, that the potential coil of one element may be open circuited or the current coil short circuited. This would cause the effect noted.

Indicator for Blown Fuses. Ans. Ques. No. 503.

An indicator for blown fuses on low voltage can be made consisting of an incandescent lamp, of proper voltage and as low wattage as can be obtained, connected in shunt with the fuse. When the fuse blows the lamp will light up.

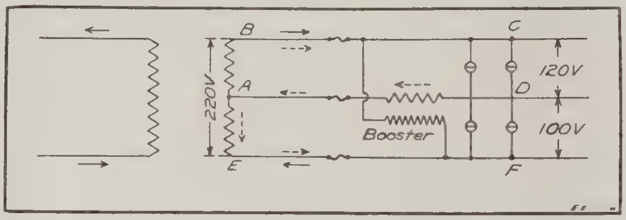
For fuses in the primary of a high potential transformer a no-voltage relay across the secondary connected to a bell or a lamp can be used. In this case the lamp will go out when the fuse blows.

Henry A. Davis.

Peculiar Action of Booster. Ans. Ques. No. 500.

Editor Electrical Engineering:

Referring to C. E. B.'s question in the January issue of the Electrical Engineering, a study of the instantaneous direction of current will at once show why the voltage is higher on one side of the three-wire mains than the other, when a booster is used in the neutral. Suppose the current for a given instant to be flowing in the direction in-



dicated by the arrows in the accompanying sketch. The full line arrows represent the direction of the main current and the dotted arrows represent the direction in which the booster current is tending to flow. It is evident from this illustration that the booster is decreasing the voltage in circuit AEFD and increasing it in circuit ABCD.

A reversal of either primary or secondary leads of the booster will reverse this order. H. H. Wikle.

Peculiar Action of Booster. Ans. Ques. No. 500.

Editor Electrical Engineering:

Regarding C. E. B.'s trouble with the booster in the neutral as described in the January issue, it was what should be expected.

In the three-wire system with a balanced load there is no current flowing in the neutral. In other words, if the current consuming devices between the positive side of the system and neutral use the same amount of current as the current consuming devices between neutral and negative, the current will flow directly from the positive side to negative and the neutral might just as well be cut out altogether.

If, however, there is more current used between the positive side and neutral than on the other side, the unbalanced will return through the neutral to the neutral connection at the machines and to the negative side of the positive generator. If the unbalanced is on the negative side, the current in the neutral will flow in the reverse direction from the positive side of the negative generator to the neutral connection and through the neutral to the load. In one case the current flows in the neutral from the load to the machine and in the other it flows from the machine to the load, the direction of the current in the neutral depending on which side is unbalanced.

Obviously then, it is impossible to boost both sides of the system by boosting the neutral because it must oppose or buck one side or the other. Thos. G. Thurston.

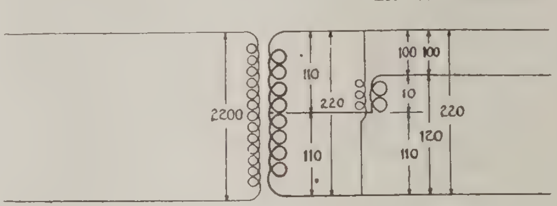
Action of a Booster. Ans. Ques. No. 500.

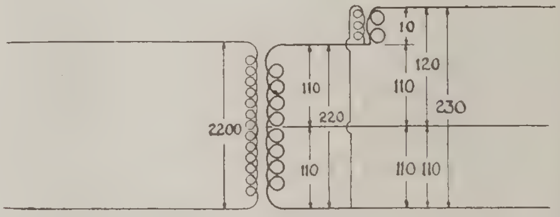
Editor Electrical Engineering:

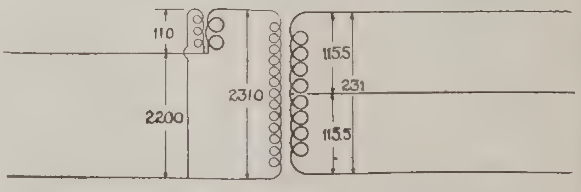
The action of the booster in question No. 500 is shown by the accompanying diagrams. By placing the booster in the neutral, its potential was raised or lowered with respect to one outside wire and lowered or raised with respect to the other, depending on the direction of the secondary connections. The operation with the booster in one outside line is shown in the second diagram. Such an installation would not maintain a balance between the two sides of the system since only the potential on one side of the line is boosted but if, as is probably the case, the resistance of the neutral is comparatively high, the differences of potentials between either outside line and the neutral will tend to become nearly equal as the load increases.

Probably one of the easiest and best solutions for this sort of problem is illustrated in the third diagram. Here an ordinary small transformer is used in the primary circuit, with its primary connected as usual, but with the secondary cut into the primary line. If the line is the usual 2,200-volt one, using 20 or 10 to 1 ratio transformers; by using a single secondary coil, the three-wire potential can be boosted to 230 volts, or by using the two secondary coils in series, it can be boosted to 240 volts. The advantages of this method are its simplicity, adjustability, the use of stock apparatus, and last but not least, the potentials of the three-wire system are equal.

R. W. Goddard.





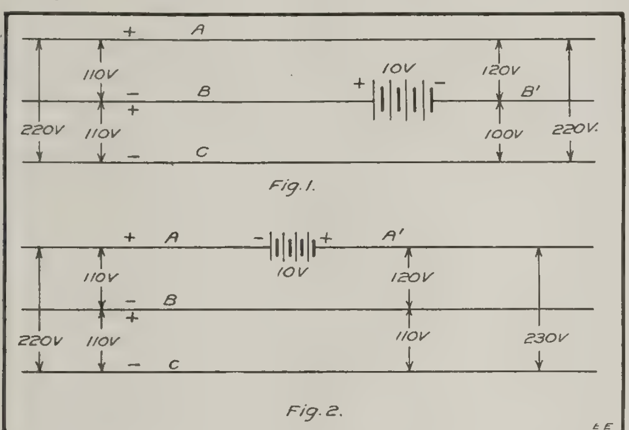


Connections for Booster in 3-Wire Circuit.

Action of a Booster. Ans. Ques. No. 500.

Editor Electrical Engineering:

The following will answer the question by C. C. B. in the January issue. To illustrate his trouble, take a direct current 3 wire system with a battery connected as shown above. Assume (C) to be zero potential then (B) would be + 110 and (A) would be + 220. Difference of potential (voltage) between (B) and (C) would be 110 — 0 = 110 and between (A) and (B) would be 220 — 110 = 110. Potential of (B) then = (B) — 10 = 110 — 10 = 100. Therefore difference of potential (voltage) between (B) and (C) = 100 — 0 = 100, and between (A) and (B) = 220 — 100 = 120.



Figs. 1 and 2. Showing Action of a Booster With Different Connections.

In other words, if the 10 volts were generated by a battery, the battery would boost in the circuit (A), (B), (B¹),)A) and oppose in the circuit (B), (C), (B¹), (B). Now in an alternating circuit the + and — values would change with each alternation and the same reasoning applied to the — alternation, could be followed out by interchanging, or reversing, all the signs in the diagram. By putting the 10 volts boost in one outside wire it can be similarly proved that the voltage of the boosted side will be 120, of the unboosted 110 and of the outside 230.

W. H. Fellows.

Lightning Arresters for 2,200 Volt Service. Ans. Ques. No. 501.

Editor Electrical Engineering:

The number of lightning arresters for a given line depends to some extent on the country passed over by the line and the average number of electrical storms in the vicinity. Average conditions require about one arrester to every 1,000 feet of line so that if the number of arresters used are designed for the voltage and frequency of the line, there will be no danger from grounds. Some trouble has been experienced in suppressing the arcing between the brass cylinders in the arresters mentioned when used on circuits having low power factor or a frequency of 25 cycles.

Homer R. Long.

Single Pole Lightning Arresters for 2,200 Volt Service. Ans. Ques. No. 501.

Editor Electrical Engineering:

Referring to question by V. K. S. as published in the January issue of Electrical Engineering, the Westinghouse type "C" lightning arrester, should be used on circuits not exceeding 200 kilowatts, within a radius of two miles of the source of power, and an additional 100 kilowatts capacity is permissible for each additional mile. About five arresters per mile are recommended. The arrester is a single pole design and for a three-phase circuit, three single pole arresters are required. This would mean fifteen type "C" arresters per mile, giving five points of protection per mile, three arresters at each point of protection. For all capacities beyond the limit given above, a larger size arrester than the type "C" should be used.

John Selzer, Jr.

Number of Lightning Arresters Required on a 2200 Volt Circuit, Ans. Ques. No. 501.

Editor Electrical Engineering:

The amount of trouble experienced by a line due to lightning for any given location, depends chiefly upon its insulation against ground, and it is safe to say that the higher the insulation of a line the more immune it will be from lightning effects. This is the reason why very high-voltage lines, while having a lower factor of safety, suffer less from lightning than do comparatively low-voltage lines.

The best way to protect a line is to insulate it as highly as it is feasible to do, and introduce weaknesses—namely lightning arresters—at frequent intervals. A ground wire also offers considerable protection from induced charges, but is of comparatively small use against direct strokes. The installation of a ground wire for the protection of 2200 volt circuits would hardly be justified, in the ordinary way, on account of the comparatively low insulation of the line against ground, and because of the low value of the spill-over voltage of the insulators.

I believe that the number of lightning arresters used in the present instance to be excessive, unless the locality is particularly susceptible to thunder storms of a very severe nature. The chief objections against the use of a greater number of lightning arresters than really required is the unnecessary capital outlay, and the greater liability of service interruptions due to the arresters short-circuiting between phases, or between any phase and ground, either of which dilemma may occur with any arrester except, perhaps, those of the horn gap type. The arresters should be fused, of course, which lessens the likelihood of trouble, but on the other hand may reduce the degree of protection. The type "S" Westinghouse arrester of the same make will probably be more suitable for the purpose in the problem, as they are more rugged than are the type "C" arresters.

The protection of the 50 Hp. motor is, of course, of greater importance than that of the line, and I believe satisfactory protection can be obtained if arresters are simply installed at each end of the line, and perhaps, one arrester per phase in the middle. I. L. K.—Rankin.

Action of Partial Ground on St. Ry. System. Ans. Ques. No. 513.

Editor Electrical Engineering:

In reply to question 513 by C. A. H., the leakage to ground decreases on account of the voltage drop. As the load increases, the drop increases and as there is less voltage, a smaller current will flow according to Ohm's Law, I = E ÷ R. If the leak is near the plant, the difference will be small but at a distance, it will be large. The writer has seen cases where the voltage has dropped from 575 at the plant to 250 a few miles away when a car was on the line.

W. N. Sackett.

ELECTRICAL ENGINEERING

DANIEL H. BRAYMER, Editor.

Devoted to the generation, transmission and distribution of electrical energy for lighting, heating, power and traction. Correspondence suitable for the pages of ELECTRICAL ENGINEERING is solicited and paid for. Name and address of correspondents must be given,—not necessarily for publication.

Published monthly by the W. R. C. SMITH PUBLISHING CO., at Dalton, Ga.; editorial and advertising departments, Grant Building, Atlanta, Ga. Entered as second-class matter at the postoffice at Dalton, Ga. Subscription rate $1.00 for two years; Canada $1.00 a year; foreign $1.50 a year.

Vol. 47. APRIL, 1915. No. 4

CONTENTS.

The question in Atlanta these days is—"Is the jitney bus to be or not to be?"

It costs $20.70 to talk three minutes over the New York San Francisco telephone line and $6.75 for each additional minute. This is one case when talk is not cheap.

During the past seven years the cost of living has increased about 37 per cent. During this same period the cost of a kilowatt-hour to the public has been reduced about 17 per cent. Economical generation and distribution tendencies have been responsible for this reduction.

The new Equitable Building of New York City will use 220 miles of rigid conduit weighing 983 tons for its wiring system. The electrical demand in light and power is 3,500 horsepower.

This building will be occupied by 15,000 people, have 1,300,000 square feet renting space and return $3,000,000 per year in rent. Forty-eight elevators with a trackage of four miles is required to handle passenger and freight traffic in this building.

Electrolytic Production of Aluminum.

Until the past year practically all the metallic aluminum produced in the United States has been made in the North from Southern and imported ores. According to geological authorities, the bulk of the aluminum ore will always come from the South, for the present supply of bauxite is entirely of Southern origin, being found as deposits in the states of Tennessee, Georgia, Alabama and Arkansas. While the production of metallic aluminum in this country from an industrial standpoint is yet in its early stages, the startling increases in the output of this, the youngest of commercial metals, and the extended applications of same, place it among the interesting developments of the future. During the past few years or since 1908, the output of this metal has increased from 6,000 net tons per year to 36,000 net tons for the year 1913.

Two plants for producing electrolytic aluminum from Southern ores are now located in the South. One at Maryville, Tennessee and the other at Whitney, N. C. The Maryville plant is owned by the Aluminum Company of America, the largest manufacturer of aluminum in this country and this plant was placed in operation last year. While its capacity is small as compared with some of the others operated by this company, it is an important factor in the development of the industry in this section. The Whitney plant is controlled by French capital and the work said to be under the direction of French metallurgists. Construction on this plant was suspended last fall on account of conditions brought about by the European war, however, it is practically certain that it will be completed in the early future. The plans for these works are extensive, the capacity being sufficient it is said, to double the present American output of aluminum when in full operation.

The Whitney plant is of special interest on account of the fact that work on the plans was started in 1901 and has been in the public eye as a proposition of wonderment on account of the capital invested and never used. With an idea of securing abundant hydroelectric power one elaborately constructed dam of cut stone has been built and abandoned at a cost of around $3,000,000 and a new structure started which will cost around $2,000,000 more. French capital has been largely involved and the present promoters of the work at Whitney, the Southern Aluminum Company is a French concern, having the well known Dr. Heroult as its engineer. From an electrical standpoint, the equipment of the Whitney plant is of special interest since it calls for the largest direct current generators yet built. The initial installation calls for five double water wheel direct connected, direct current generators of 5,200 Kw. each, with arrangements for 18 of these units and two alternating current units of 1,200 Kw. each.

The production of aluminum in the South is of interest not alone as a promise of an important Southern development but interesting on account of the features involved that make it a part of the most important electrochemical industry of today. On account of the secrecy maintained in connection with the manufacturing processes, little can be said of the nature of the equipment used in the plants named. It is generally known, however, that the bauxite ore is first treated in an electric furnace to drive off water and eliminate impurities. This leaves a product known as "alumina" in nearly pure state which is drawn off while fused. This alumina is then dissolved in a fused bath of cryolite and direct current passed through the solution, the alumina being decomposed by the electrolytic action and aluminum deposited as a fused metal. About two pounds of alumina are required to produce one pound of aluminum.

Elsewhere in this issue, the electrical plant of the Maryville works of the Aluminum Company of America is described. In this plant nine rotary converters of 2,500 Kw. capacity each are installed and operated on power furnished by the Tennessee Power Company. This block of power has presented attractive features to this power company and special arrangements have been provided at a considerable expenditure to make possible a continuity of service under the most adverse of circumstances. The transmission line may be fed from three separate stations, two operated by the Tennessee Power Company and the Hales Bar plant of the Chattanooga and Tennessee River Power Company. Equal precautions have been taken to protect the service through failure of the line. Although the capacity of the Maryville plant is said to be small as compared with some others, its power contract calls for around 20,000 horsepower so that with the further extensions of the company in this district which are probable for the early future, it is certain that the production of aluminum is to be an important factor in the generation and use of electrical energy in the South on an extensive scale for a single and rather concentrated industry.

Selling Current Consuming Devices.

The selection and sale of those types of current consuming devices that possess a popular appeal and net a profit to electrical dealers and central stations, is a problem. In most cases the features of this problem which are most perplexing and make its solution difficult are brought about by the numerous new makes and designs of so-called heating devices, washing machines, vacuum cleaners and electric stoves and ranges being placed on the market, for any selection of a make or a design which will be in demand in the future is a matter of considerable speculation. As a general rule, however, the devices now available that are substantial in design and least freakish, promoted by manufacturers who have enough confidence in their product and their ability to produce it in the face of the keenest competition on a quality basis and who are willing to cooperate with jobbers and dealers in its sale, are devices that can now be considered profitable when the proper amount and character of local sales work is placed behind them. Goods of this kind packed in boxes, or stored on shelves will not sell themselves for they have not come to be recognized as necessities in even the well-to-do home. The merchandising methods that will make these goods move must therefore be suited to the standard of living of possible buyers and the arrangements that can be made to stock and handle the devices at the smallest cost. Goods that will sell in one town or city will not move at all in another and goods that may sell during one season of the year will be in little demand in another. The purchase of a stock of devices then, by any dealer who is not prepared to make their sale a study is a serious problem and one in which there is little likelihood of even reasonable returns. On the other hand with a proper cooperation between electrical dealers, central stations and manufacturers supplemented by carefully worked out merchandising methods, the sale of current consuming devices is a proposition with a nice profit attached.

It has been said that in the average case, the cost of handling and selling current consuming devices is nearly equal to the cost of handling dry goods. To arrive at a gross cost on which to figure profit, it seems that it is fair to add at least 25 per cent to the cost of the device. The average costs for the department store run about 27 per cent and with electrical jobbers about 20 per cent so that 25 per cent is a reasonable amount for the average electrical dealer to add to cost of devices to him when determining a gross cost. A fair profit to the dealer on this business is another 25 to 30 per cent so that the retail price mark for electrical devices handled by dealers should be set about 25 per cent above the gross cost arrived at as above. In some cases local conditions and sales arrangements will permit a readjustment of this basis and a cut in the selling profit to secure volume of sales but in all cases the business over any period should measure up to the figures given.

If the dealer takes up the sale of this apparatus on a carefully planned merchandising basis and studies his field to learn the possible uses of devices among his customers and knows in a general way their buying capacity, he is in a fairly good position to know on what basis to stock the different appliances and expect to realize the possible profits. The greatest drawback at present among dealers is not the over-stocking of these devices but the failure to take advantage of the popular tendency in buying and to study and adopt the methods that will unload their stocks and create a demand that will keep future stocks moving. A great deal can be learned from a study of the "Five and Ten Cent Store" business that will aid electrical dealers in this regard for here the law of supply and demand and the seasonable demands of buyers coupled with the turning over of stock many times per annum is the secret of the success that has attended the growth of this business.

Good window displays, coupled with proper local advertising, letter and personal solicitation will usually accomplish the desired results in the same manner as already established by the novelty and department store. Electrical devices appeal especially during certain times of the year and advantage should be taken of this fact. The spring is the time for fans and vacuum cleaners, the summer is the time for washing machines, electric stoves, ranges and cooking devices, while the fall is the time to push small heaters, percolators, toasters, etc., with the other numerous small devices most seasonable during the Christmas holidays and on special occasions such as weddings, birthdays, anniversaries and the like. Electrical dealers who have followed the columns of the daily papers and the announcements of weddings and social affairs, listing these events for present and future reference have soon found that an excellent mailing list is secured that brings direct orders.

Concerning the Electrical Trade

News of Activity by Jobbers, Dealers, Contractors, Central Stations and Manufacturers.

J. J. Smith, Vice-President and General Manager Atlanta Branch of Baltimore Electric Supply Company.

When the Baltimore Electric Supply Company of Baltimore, Md., decided to establish a Southern branch in 1912, the man selected to secure the business and be responsible for the success of the branch was young in years, but old in the electrical business. This man was Mr. J. J. Smith, the assistant to W. J. Flannery, president of the company. What Mr. Smith has done since coming South is best told by the fact that he was given barely a handful of customers to start with, mainly those the home office had secured through mail solicitation, and now has on his books after three years, over 3,500 regular customers.

J. J. Smith, Vice-President and General Manager, Baltimore Electric Supply Co., Atlanta, Ga.

Mr. J. J. Smith was born in Baltimore, Md., August 3, 1878, and received his education in the public schools of that city and at the Baltimore City College. At the age of nineteen he secured employment with the United Electric Light & Power Co., of Baltimore, and for six years held the position of general storekeeper. When that company consolidated with the Gas Company under the name of the Consolidated Gas, Electric Light & Power Co., in 1903, Mr. Smith was made purchasing agent for the new organization, which position he held for five years, resigning in 1908 to go with the Baltimore Electric Supply Company as assistant to the president. In this position he had entire charge of the city sales.

On March 1, 1912, the Atlanta branch of the company was opened as a Georgia corporation and organized as a separate and distinct business as far as the Baltimore office was concerned. A general electric supply business is conducted and leading lines carried. Mr. Smith's pet phrase in reply to an inquiry on the extent of his business is "We sell everything electrical except the current." The company covers the states of Georgia, Florida, South Carolina, Alabama and Tennessee, and travels three road men. A general catalog is regularly issued and the following lines are handled:

Schedule Goods:—
- Arrow Electric Co., Hartford, Conn.
- H. T. Paiste Co., Hartford, Conn.
- Hart & Hegeman Mfg. Co., Hartford, Conn.
- Harvey Hubbell, Inc., Bridgeport, Conn.

Switches, Fuses & Cut-outs:—
- Trumbull Electric Co., Plainville, Conn.
- Chicago Fuse Mfg. Co., Chicago, Ill.

Conduit—Rigid:—
- Enameled Metals Co., Pittsburgh, Pa.

Conduit—Non-Metallic & Flexible Metallic:—
- National Metal Molding Co., Pittsburgh, Pa.
- Safety Armorite Conduit Co., Pittsburgh, Pa.

Wire—Rubber Covered and Lamp Cord:—
- National India Rubber Co., Bristol, R. I.

Service Boxes—Iron:—
- F. Bissell Co., Toledo, Ohio.
- Columbia Metal Box Co., New York City.

Condulets and Taplets:—
- Crouse-Hinds Co., Syracuse, N. Y.
- H. T. Paiste Co., Hartford, Conn.

Lamps—Incandescent:—
- Colonial Lamp Division, National Lamp Works of G. E. Co., Warren, Ohio.

Flash Lights and Auto Lights:—
- American Ever Ready Co., New York City.

Transformers—Meters and Motors:—
- Westinghouse Elec. & Equip. Co., Pittsburgh, Pa.

Fans:—
- Colonial Fan and Motor Co., Warren, Ohio.
- Hunter Fan and Motor Co., New York City.

Pole Line Hardware:—
- Schaper Construction Material Co., New York City.

Porcelain and Glass Insulators:—
- T. H. Parker, Parkersburgh, W. Va.
- The Brookfield Glass Co., New York City.

Lightning Arresters:—
- The Electric Service Supplies Co., Philadelphia, Pa.

Glassware and Reflectors:—
- Holophane Works of G. E. Co., Cleveland, O.
- The Benjamin Elec. & Mfg. Co., New York City.
- The Nat'l X-Ray Co., Chicago, Ill.

Fixtures and Portables:—
- Faries Mfg. Company, Decatur, Ill.

Street Lighting Fixtures:—
- George Cutler Co., South Bend, Ind.

Heating Devices:—
- Landers, Frary & Clark, New Britain, Conn.

Vibrators:—
Standard Electric Works, Racine, Wis.
Motor Rheostats and Starters:—
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Bell Ringing Transformers:—
Packard Electric Co., Warren Ohio.
Dry Batteries:—
Manhattan Elec. Sup. Co., New York City.
Inter Communicating Telephones:—
Deveau Telephone Mfg. Co., Brooklyn, N. Y.
Ericsson Mfg. Co., Buffalo, N. Y.
Lamp Guards:—
Harvey Hubbell, Inc., Bridgeport, Conn.
W. N. Matthews & Bro., St. Louis, Mo.
McGill Mfg. Co., Valparaiso, Ind.

Price Reductions in Tungsten Lamps.

Practically all the sizes and types of tungsten multiple lamps are affected by reductions in list prices put into effect April 1st, 1915, by the Edison Lamp Works of General Electric Company. On the regular straight side and round bulb lamps, from the 10-watt to the 250-watt sizes, also on sign lamps, stereopticon lamps, etc., the reductions range from 3 to 20 cents per lamp, according to the size. These reductions, which average about 10 per cent and will tend to further popularize the tungsten lamp.

The new concentrated filament vacuum lamp of 25, 40 and 60-watt sizes now list at only 5 cents per lamp more than the regular lamps of corresponding sizes. For the gas-filled, multiple lamp of 100 to 1000-watt sizes, the reductions range from 50 cents to $1.00 per lamp, the average reductions being between 20 and 25 per cent. The introduction of gas-filled lamps has been exceptionally rapid. Over a million are already in use. The decreased cost of these lamps will undoubtedly result in a still more rapid replacement of vacuum lamps by the more efficient gas-filled units.

National Electrical Prosperity Week.

On March 4th, thirty prominent salesmen and publicity managers met at the offices of the Society for Electrical Development for the purpose of carrying out the decision of the society's executive committee to ask leading commercial men to select a steering committee to make plans for celebration of National Electrical Prosperity Week.

Mr. Henry L. Doherty, president of the Society, acted as temporary chairman and advised the representatives of some of the work that has been accomplished and of the tentative plans for "electric week." Following this, Mr. E. W. Loyd, general contract agent of the Commonwealth Edison Company of Chicago, was made chairman. There was considerable discusion as to the proper time for celebrating such a week—whether for this fall or in the spring of 1916. The consensus of opinion that while perhaps a year might be taken to get the maximum efficiency, yet the industry needed a revival now and that this fall would undoubtedly be the best time, considering all conditions. It was decided to leave the matter to analysis by the steering committee and it is expected that a definite date will soon be fixed.

In regard to the selection of a steering committee, it was decided that Chairman E. W. Lloyd and the general manager of the Society, J. M. Wakeman, should select a nominating committee of five men representing the varied interests, they in turn to select the 25 men for the committee and represent the central stations, manufacturers, jobbers, contractors, dealers and technical press. One man from each interest will be named as chairman of his division. Messrs. Lloyd and Wakeman named as a nominating committee, George Williams of the Cities Service Company, representing central stations; Ray D. Lillibridge of the Wagner Electric Company, for the manufacturers; E. W. Rockafellow of the Western Electric Company, for the jobbers; J. R. Strong of the Tucker Electric Construction Company, for the contractors, and Hugh M. Wilson of the "Electrical World" representing the trade press.

The executive committee of the National Electric Light Association at a recent meeting voted unanimously to support the movement. This action insures the support of the 14,000 members of the N. E. L. A., including the leading central stations of the country.

Manufacturers of Electrical Supplies Create New Association.

At a meeting of manufacturers of electrical supplies held March 9 at Hotel Biltmore, New York City, the constitution and by-laws governing a new association were presented and adopted. This organization will be known as the "Associated Manufacturers of Electrical Supplies" and has as its object as set forth in its constitution, the advancing and protecting of the interests of manufacturers of electrical supplies and materials entering into electrical construction, manufacturing, engineering, safety and other problems; to promote the standardization of electrical material; to collect and disseminate information and to promote co-operation among the members of the organization.

The affairs of the association will be handled by a board of 15 governors elected at an annual meeting. Each year five new governors will be elected to serve for a term of three years. This board of governors elects from its number a president, a vice-president and a treasurer to serve for one year. The secretary is also appointed by the board and is to be the only paid official. The annual meeting of the association is set for the third Thursday in March of each year.

The membership of the new organization will be made up of the companies and individuals engaged in the manufacture of electrical supplies or materials entering into electrical construction. The membership will be devided into groups according to the nature of the supplies and materials manufactured, and these groups will be known as association sections. Any member can become a member of any one or more sections when the products made so entitle such section membership.

The following make up the present board of 15 governors:: A. W. Berresford, Cutler-Hammer Manufacturing Company; Charles Blizard, Electric Storage Battery Company; LeRoy Clark, Safety Insulated Wire and Cable Company; H. B. Crouse, Crouse-Hinds Company; D. C. Durland, General Electric Company; H. R. Holmes, R. Thomas & Sons Company; J. F. Kerlin, National Carbon Company; Everett Morse, Simplex Electric Heating Company; J. W. Perry, H. W. Johns-Manville Company; W. C. Robinson, National Metal Molding Company; Walter Cory, Westinghouse Lamp Co.; Walter Robbins, Wagner Electric Manufacturing Company; R. K. Sheppard, B. F. Goodrich Company; Gerard Swope, Western Electric Company; Dr. Edward Weston, Weston Electrical Instrument

Company. This board elected the following officers for the coming year: President, Robert K. Sheppard; vice-president, H. B. Crouse; treasurer, James W. Perry.

The next meeting of the association's governors will be held in New York City shortly after this issue goes to press and will be reported in our next issue.

Whitney Eve Company of Augusta, Ga., Secures Good Contract—Build-Now Campaign On.

The build-now campaign seems to be well launched in Augusta, Ga., judging from the recent building permits issued. Early in March work was started on eight handsome residences, a three-story reinforced concrete and steel building on Walker Street, a warehouse and office building on Reynolds Street, and a concrete automobile assembling plant on Eleventh Street.

The Whitney-Eve Company, electrical engineers and contractors of Augusta have secured the contract for electrical work in the $10,000 warehouse and office building on Reynolds street.

The Southern Public Utilities Company Magazine.

The Southern Public Utilities Company of Charlotte, N. C., has organized a publicity department and placed in charge Mr. Leake Carraway. Mr. Carraway is also editor of the company's house organ, which appeared February 10, as an attractive 28 page publication 6 by 9 inches. The work of the newly organized advertising department is explained in the following quotation from the editor's announcement and seems to be an excuse for maintaining the house organ.

"The department is probably erroneously named, since it will deal with the affairs of the company, for the information and pleasure of the men employed by the company, through this magazine, and will not be, in the generally accepted meaning of the term, a publicity department."

Newspaper Co-operation in New Business Campaigns.

The newspapers of this country are gradually coming to recognize the value of central station campaigns to improve the lighting of streets, parks and drives. As an example of the right sort of co-operation in this kind of civic improvement, we publish below an editorial carried in a California daily, called to our attention by Mr. Ross B. Mateer, commercial agent of the Southern Sierras Power Company. Mr. Mateer says that this help given in a recent porch lighting campaign has been productive of results. The editorial follows:

"Rainy days, slippery streets and dark evenings make travel unsafe for the worker hastening homeward after a day of toil. A misstep and expense looms up large in front of the pedestrian, and insurance is eagerly sought as a preventative of future accidents. Protection is thus assured individually, but what of your home, those whose roof it shelters, and what of the safety of other pedestrians who must travel the dark gloomy street?

"To assume large premiums for insurance is burdensome to many, to risk ones safety is a menace to your home. The only sensible economical and convenient method assuring safety to you and yours, of doing your share in encouraging well lighted streets, thereby showing your co-operation with municipal authorities, is by the use of one of the new low wattage tungsten lamps on your front porch, burning if you please each night of the year from dusk of one night until daylight of the following morning.

"Were each residence to be illuminated with a small tungsten lamp burning every night what a boon it would be for the city. Believing that some of our subscribers might hesitate to comply with our campaign for well lighted streets we have ascertained that burning a 25 watt tungsten lamp ten hours each night will cost only two and one-quarter cents or about 75 cents a month. Cheap insurance, we believe.

"It is our purpose to show shortly a few of our streets, as the photographer finds them. Will you be residing on a brightly lighted thoroughfare?"

American Ever-Ready Company of New York City Establishes Southeastern Office.

The American Ever-Ready Company, a manufacturer of batteries, flashlights and electrical instruments, with main offices in New York City, has during the past month made arrangements to open a Southeastern headquarters at Atlanta, Ga. A three-story brick building has been leased at Nos. 383-7 Whitehall street where about 25,000 square feet of floor space is available for warehouse purposes.

Mr. L. L. Shivers, vice-president of the W. E. Carter Company of Atlanta and a jobber for the American Ever-Ready Co., working with the Atlanta Chamber of Commerce has been largely responsible for the addition of the Southern office of the American Ever-Ready Company to the long list of Atlanta headquarters of northern manufacturers now doing business in the South. The new office will be in charge of Mr. William G. Miles as manager.

Public Enemies.

If you build a line of railway, over hills and barren lands,
Giving lucrative employment to about a million hands;
If you cause a score of cities by your right-of-way to rise;
Where there formerly was nothing but some rattlesnakes and flies;
If when bringing kale to others, you acquire a little kale,
Then you've surely robbed the peepul and you ought to be in jail.

If by planning and by toiling, you have won some wealth and fame,
It will make no odds how squarely you have played your little game;
Your success is proof sufficient that you are a public foe—
You're a soulless malefactor, to the dump you ought to go;
It's a crime for you to prosper where so many others fail;
You have surely robbed the peepul, and you ought to be in jail.

Be a chronic politician, deal in superheated air;
Roast the banks and money barons, there is always safety there;
But to sound the note of business is a crime so mean and base,
That a fellow guilty of it, ought to go and hide his face.
Change the builders' song triumphant for the politicians' wail,
Or we'll think you've robbed the peepul and we'll pack you off to jail.—Walt Mason, in Graphite.

The Current Consuming Device---What to Sell and How to Sell it

BY A. I. V. WILSON.

The successful sale of current consuming devices presents a problem to the electrical dealer, the solution of which is of vital importance to the manufacturer, jobber and central station as well as to the dealer. The question in the minds of most dealers is, "What to sell and how to sell it?" "What to sell" should include not only the items for which a demand has already been created but also such devices as have been designed to meet certain needs, and will sell at a good profit, if properly pushed. This latter class can be brought before the consumer in such a manner that they will not only realize the value of the devices but be so thoroughly convinced that they will place their orders for them.

Manufacturers of practically all current consuming devices have been pushing extensive advertising campaigns in magazines and other mediums in order to bring their devices to the attenton of the public. This is a very necessary part of sales work but does not complete it. An equal if not more important part is left for the dealer to play in bringing these goods to the attention of his customers and convincing them not only of their utility, but with the fact that he carries them in stock and is prepared to furnish and back them up as a good investment. The general advertising of the manufacturer informs the public that certain devices have been provided to meet their needs, and although this alone results in many inquiries and sales, the bulk of the business to be obtained can only be secured by a personal touch between the dealer and his local trade.

A study of the daily papers, street car and circular advertising by local dealers will show that the principal items covered are food stuffs, clothing and household furnishings. Articles of this kind have the strongest competition and the financial standing of firms handling these lines of business and doing extensive advertising is sufficient to prove that sales work of this kind pays well, yet it is surprising to note the small amount of such advertising being used by electrical dealers.

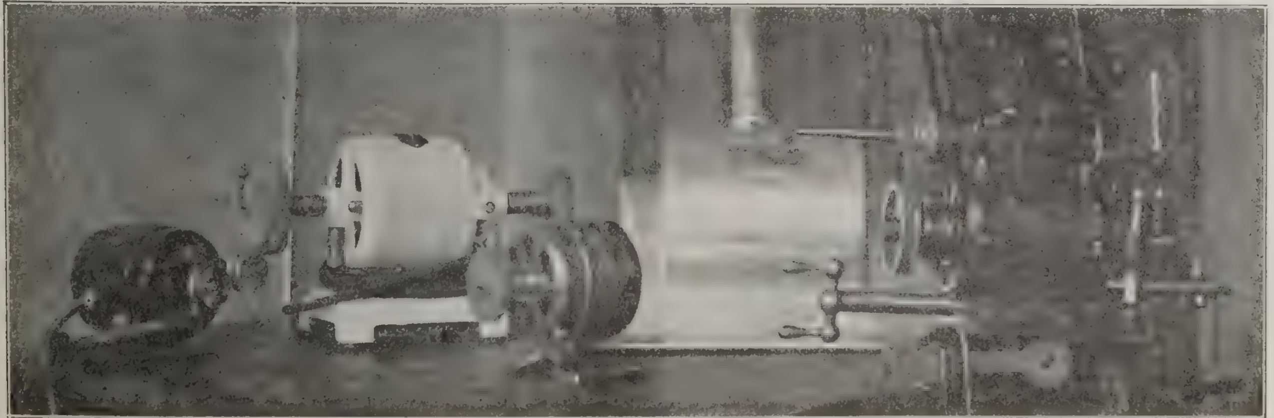
With so many responsible manufacturers placing current consuming devices on the market, a dealer has little trouble in securing a good line, but this alone is not sufficient. The line must have good selling points. The convenience, efficiency and economy of a device are of greater importance to the consumer, than knowing how long the manufacturer has been in business, and these three necessary qualities are given in the order of their importance from a dealer's selling standpoint.

That a vacuum cleaner will replace the broom and dust rag and is built by some special manufacturer is not sufficient; it is of more interest to the consumer to know that it is a sanitary device, will clean rugs thoroughly and brighten them up, and that a child of eleven or twelve years of age can operate one equally as well as an adult. There is no question in the minds of the public that an electric toaster will actually toast bread, but this fact alone has not brought the business which the device justifies. The convenience of having nice hot crisp toast prepared as you want it on the table, will sell more toasters than an argument regarding the amount of current consumed. That motors are made for operating a sewing machine is generally known but a prospect is more interested when his or her attention is called to the backaches that are eliminated and the additional work that may be accomplished with less labor. Special points of convenience of the type handled thus help most in getting the order.

There has been a tendency on the part of many dealers to depend almost entirely on the advertising of manufacturers to bring these points to the attention of consumers. It must be remembered that a successful dealer is not merely a commissary, booking and delivering orders; he is a live salesman in personal touch with his trade.

The dealer's margin of profit has been fairly well agreed upon and little stock will be found on shelves where this point was not considered when securing the line. Where dead stocks do exist it will be found that after the dealer took on the line he ceased activity and made no special effort to move it or started such activity and stopped it too soon, before giving the proposition a fair trial.

One successful dealer has sold a large number of current consuming devices from circulars mailed out to selected lists and localities. Instead of advising that he had a certain device for sale at a certain price, he explained in a well written multigraph letter that, in his opinion, a great many people did not realize the convenience and economy of this device. The only request made was that he be



Small Motors and Devices Made by Wisconsin Electric Company, Racine, Wis., A. I. V. Wilson, Sales Agent, Atlanta, Ga.

allowed to demonstrate and show its value. If a sale was not made as a result of the demonstration, he was sure that a good opinion of the device would aid him in selling others, and when the time arrived that they were ready to buy he could more easily secure the business.

Lamp socket devices have not received the attention by electrical dealers that they deserve. Practically all of the merchandise advertising in the daily papers is used by department stores, household furnishers and hardware dealers, and unless the electrical dealer makes a greater effort to handle these devices successfully, the department stores and household furnishers are going to reap the benefit of a sales work which has been started by the manufacturers through general advertising and rightfully belongs to the electrical dealer.

The Sale of Electric Washing Machines and Vacuum Cleaners.

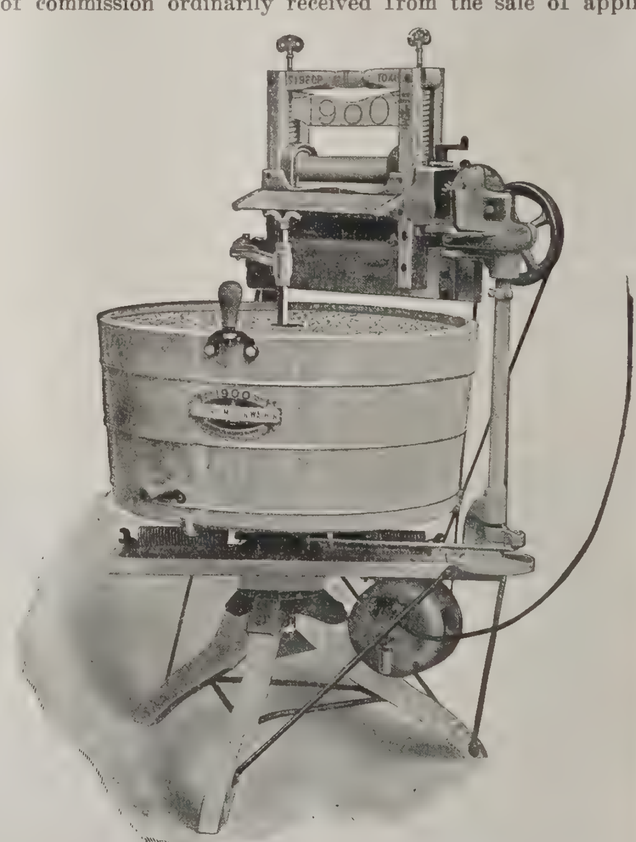
An interesting suggestion for creating interest and sales of electric washing machines and vacuum cleaners was given in the last report of the N. . L. A. committee on electrical merchandising and advertising. The plan as worked out by some of the larger central stations has been very successful and there is no reason why it should not be equally successful with a small city, in fact, it might very well be more so because of the possibility for greater concentration on the smaller number of customers to be interested. The central station, working with the dealer or manufacturer picks out a largely residential section of medium or high grade of prosperity and the dealer or manufacturer hires a hall, if possible the general meeting place of the women's organizations of that section, for an afternoon or evening display of the appliance to be specialized. The central station then sends invitations to its customers in the locality and arranges to serve coffee or tea and some light refreshments in the hall. The demonstration is sure to be well attended and as many names as possible should be obtained of those who appear to be interested.

Following the demonstration a sufficient number of young women, or if desirable, young men, are sent out on a house to house canvass of not only those who attended the demonstration, but all who were originally invited and therefore know something about the plan. These salesmen or demonstrating salespeople, in one case, were paid $10.00 a week by the manufacturer or agent and further reimbursed by the central stations and a bonus on sales effected. The central station furnished, at its own expense, one person as a sort of general director of the other salesmen to guide them in their work, keep track of what they were doing, follow all difficult leads and attempt to discover the reasons why any particular customer refused finally to purchase the machine after having been familiar with its features. The only other expense was the cost of addressing and mailing the invitations.

This form of campaign was strengthened in one instance by the manufacturer who, before the invitations were sent and the demonstrations held, sent out to the central station's list of customers, a little booklet or folder describing the washing machines. Then when the customers received the invitation to the demonstration they were not wholly unfamiliar with the article referred to.

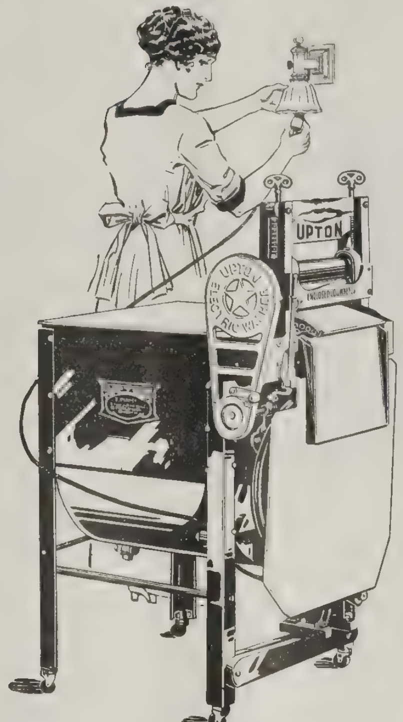
There has not been any difficulty in interesting dealers, manufacturers and agents in this form of campaign inasmuch as it is distinctly co-operative. In some cases central stations have been willing, and have found it desirable to allow the manufacturers or agents to reduce the percentage of commission ordinarily received from the sale of appli-

Power Washer Made by Meadows Manufacturing Co., Pontiac, Illinois.

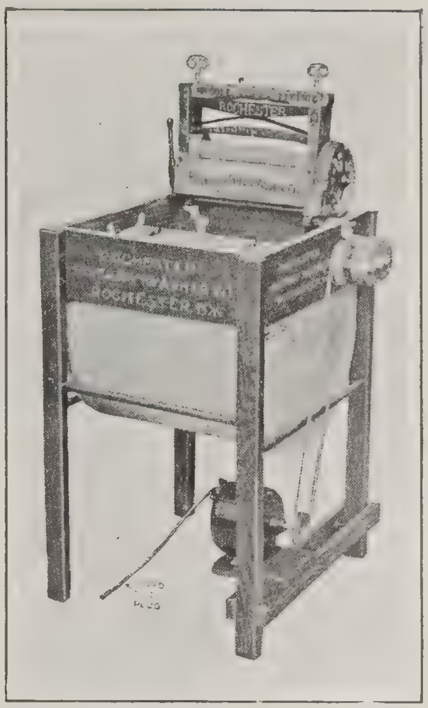


Electric Motor Washer Made by the Nineteen Hundred Washer Co.; Binghamton, N. Y.

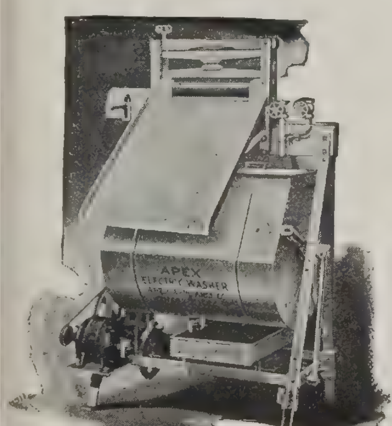
The Geyser Power Washer Made by Capital Electric Co., 321 North Sheldon Street, Chicago, Ill.



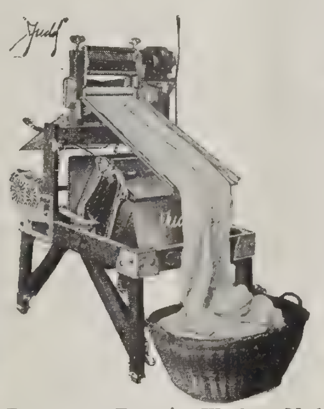
Electric Washer Made by Upton Machine Co., St. Joseph, Mich.



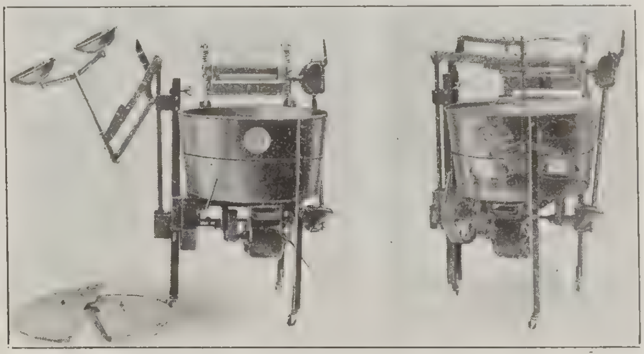
The Rochester Rotary Washer Made by Rochester Rotary Washer Co., Rochester, N. Y.



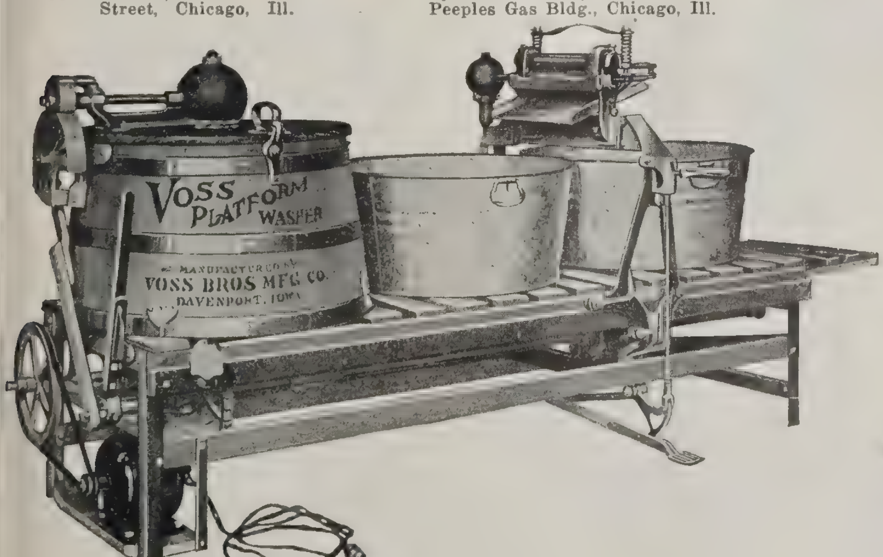
Apex No. 2 Electric Washer Made by Apex Appliance Co., 3223-9 West 30th Street, Chicago, Ill.



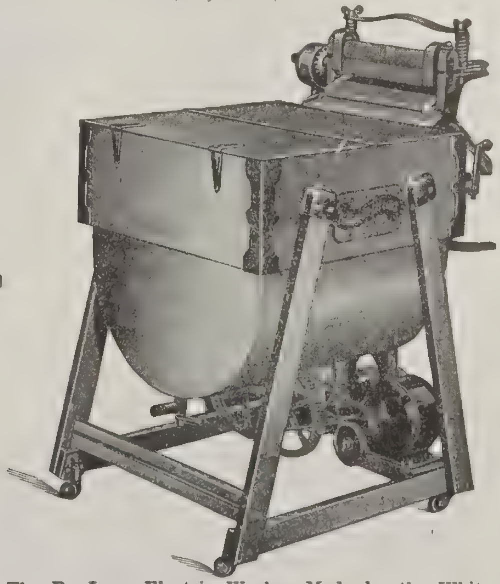
The Judd Electric Washer Made by Judd Laundry Machine Co., Peeples Gas Bldg., Chicago, Ill.



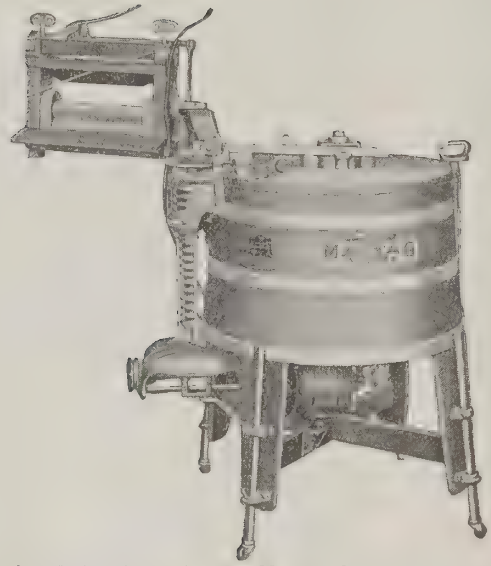
The Easy Motor Washer Made by Dodge & Zuill, 5084 East Water Street, Syracuse, N. Y.



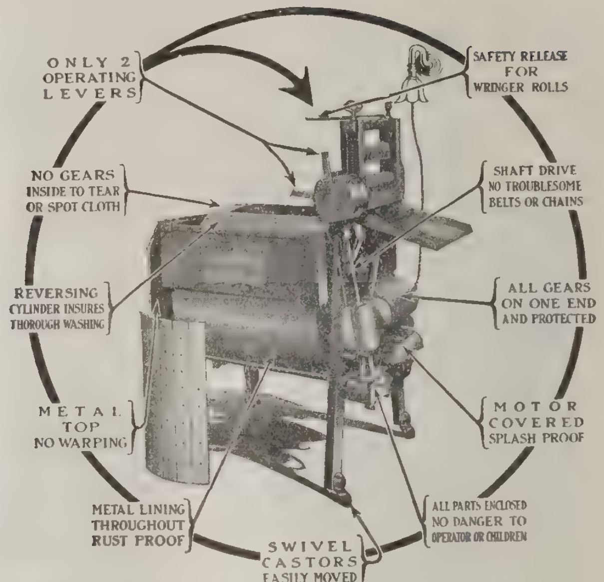
The Voss Electric Washer Made by Voss Brothers Mfg. Co., Davenport, Iowa.



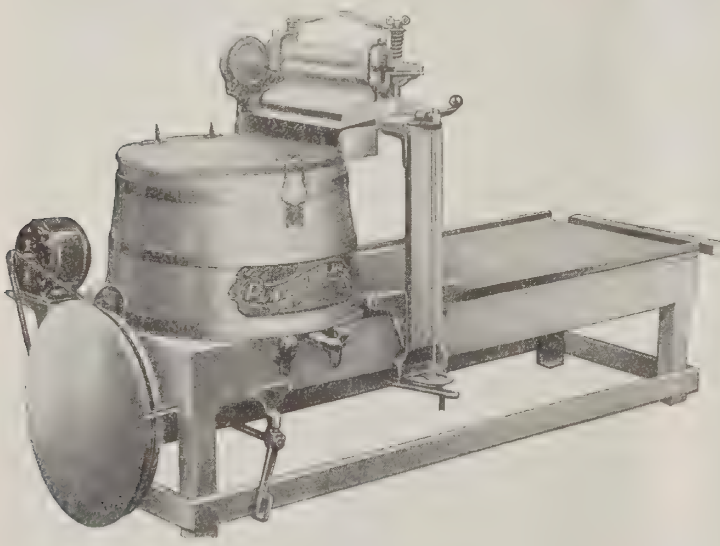
The De Luxe Electric Washer Made by the White Lily Mfg. Co., Davenport, Iowa.



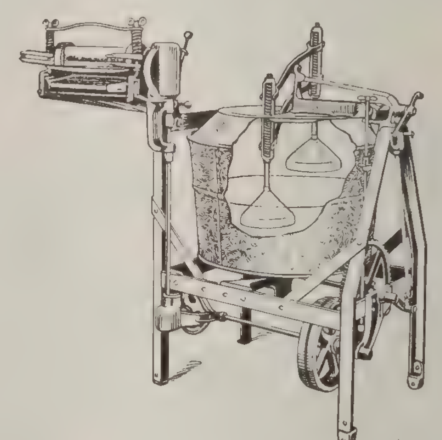
An Electric Washer Made by the Maytag Company, Newton, Iowa.



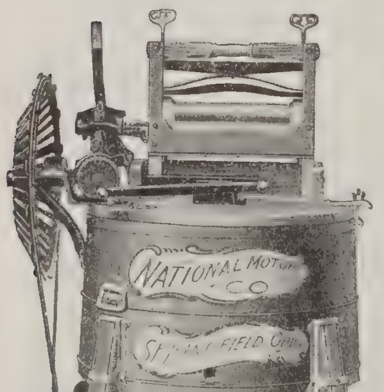
Western Electric-Conlon Electric Washer, Sold by Western Electric Company, New York City.



Platform Power Washer made by White Lily Mfg. Co., Davenport, Iowa.

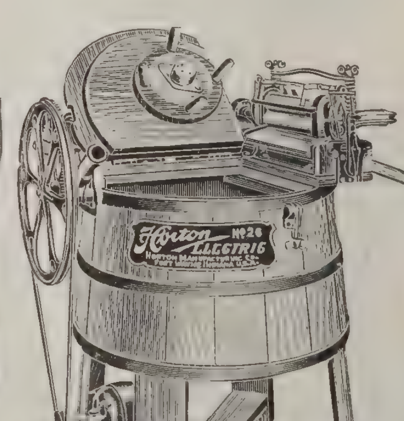


Beebe Vacuum Washer Made by Beebe Sales Co., Minneapolis, Minn.



Power Washer Made by National Motor Co., Springfield, Ohio.

Electric Washer Made by Voss Brothers Manufacturing Davenport, Iowa.



Electric Washing Machine Made by Horton Manufacturing Co., Fort Wayne, Ind.

ances, so that the manufacturer or agent might recoup for the additional expense of the demonstration and sale.

It is true that neither washing machines or vacuum cleaners bring a large income to the central station, but they become immensely valuable articles to central station customers who frequently refuse to give up the use of the machines or moving to a new residence. It is a good scheme for the dealer when worked on a co-operative plan as outlined, for many instances are known where people have declined to lease unwired houses, not because of the absence of electricity for light, but because of the lack of it as an assistant in washing and cleaning. These appliances accustom the public to the use of electricity and in a highly practical way are the greatest possible help in selling other appliances later on.

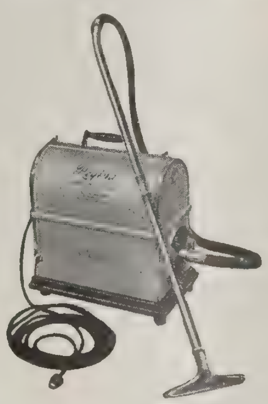
How to Introduce Electric Ranges.

In what follows the methods and experiences of Mr. F. M. Wilkes, manager of the Light and Development Company of St. Louis, Mo., in selling electric ranges are given, abstracted from a paper recently read at a meeting of central station men in St. Louis, Mo.

Electric stoves now on the market are, in general, divided into two classes: Those following the idea of the first flat iron, in which the heating coil is totally inclosed in metal, and those in which the original idea of a toaster has been developed. For each of these types the respective manufacturers, putting them on the market, claim great advantage over the other type, but I believe that due to the greater rapidity of the open coil stove it has the call over the enclosed type. Again, human nature must be taken into consideration. For countless generations women have done practically the bulk of the cooking and have come to regard a heat which they cannot see the evidence of in a red glow, as not at all satisfactory for cooking. Due to this fact, I believe anyone handling electric stoves will find it much easier to get a woman to endorse the stove of the glowing coil type than one of the enclosed type.

Having decided on an open type of coil, we now find this type in turn divided into the automatic and non-automatic types. Here again we have the same objections to the automatic as we have already attached to the enclosed type of element—that is, the human equation is not brought into play. Also, another cause of trouble is added. In clock control we meet with the danger of clock troubles and the fact that voltage variation is not taken care of. With the thermostat control we have really the most scientific and economical form of cooking device yet invented, but it is hard to realize the present day kitchen mechanic or for that matter, the present day mistress, setting the thermostat

Hoover Suction Sweeper Made by Hoover Suction Sweeper Co., New Berlin, Ohio.



Regina Model B. Electric Cleaner Made by Regina Company, 47 West 34th Street, New York City.

The Bee Model J Electric Suction Cleaner Made by Birtman Electric Co., Chicago, Ill.

The Thurman, Jr., Model 72 Vacuum Cleaner Made by Thurman Vacuum Cleaner Co., St. Louis, Mo.

'neuvac Type C Vacuum Cleaner Made by Pneuvac Company, 59 Temple Place, Boston, Mass.

Pneumatic Cleaner Model C. Made by Regina Company, 47 West 34th Street, New York City.

The Duntley Electric Sweeper Made by Duntley Products Co., Erie, Pa.

Western Electric-Sturtevant Line of Vacuum Cleaners Handled by Western Electric Co., New York City.

Everson Vacuum Cleaner Made by Everson Mfg. Co., 271 Franklin St., Boston, Mass.

Liberty Vacuum Cleaner Made by Innovation Electric Co., 585-9 Hudson Street, New York City.

Thurman No. 2 Stationary Vacuum Cleaner for a Residence Made by Thurman Vacuum Cleaner Co., St. Louis, Mo.

Cadillac Cleaner Model 15 Made by Clements Mfg. Co., 601-13 Fulton, St., Chicago, Ill.

Brilliant Suction Cleaner Made by The Sterling Machine and Stamping Company, Wellington, Ohio.

The White Cross Vacuum Cleaner Made by Lindstrom-Smith Co., 1100 South Wabash Ave., Chicago, Ill.

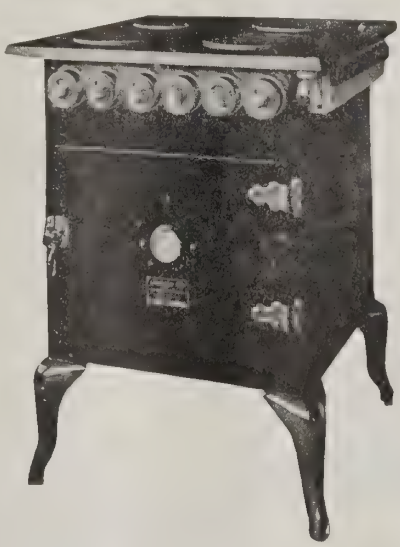
for each different operation which is necessary to perform during the day.

In selecting a stock of stoves from which to make sales, the best combination has proven so far with me at least, to be the small stove with two burners and a portable oven, a three burner and a 12 x 18 x 12 inch oven, and a four burner stove with the oven at the side, 18 x 18 x 12 inches. From these three stoves a selection can be made to suit almost any customer, except in case of a restaurant, where it is usually necessary to get a stove with larger ovens than those afforded on any of the above stoves.

Having decided on what stoves to handle and what size to carry, we are now ready to commence sales. Before starting, the selling of stoves it seemed very simple. All that seemed necessary was to put the stoves on exhibition, explaining through newspapers and by letters to prospects that here at last was a fireless cooker, one that did not take hours and hours to cook, but really, in baking, at least, reduced the time of getting a meal at least one-fourth. A campaign of this kind got no results, however. We were then confronted with the fact that this, at least, was not the way to sell stoves, no matter how well it might work when applied to other articles. Of course, it at once occurred to us to put out stoves on demonstration. But here an apparently insurmountable difficulty presented itself. An electric stove, unlike an iron or a vacuum cleaner, cannot be used off of the ordinary house service. Indeed, in order to get good results it is necesary not only to have No. 6 secondary line wire from the transformer, but at least No. 8 for the service drop and No. 8 from the service entrance to the stove. This, of course, would mean that to put a stove in a house for demonstration purposes we would have to spend from ten to twenty dollars for material and keep two men busy all day making the installation. Then if, for any reason, the stove should be thrown back on our hands, we would be out the whole cost of the test as the material in the house at least would cost more to remove than it was worth.

Just when despair over the stove question was beginning to loom up, however, the presidentess of one of the local women's clubs came in to see our stoves. She was disgusted with trying to cook on an evil-smelling gasoline stove, and agreed to take one of our stoves provided we would guarantee its cost of operation as against coal or wood. With coal at four dollars per ton it only took a few minutes to figure that we would be safe in making the guarantee in regard to coal, and it seemed pretty safe to gamble that wood would cost pretty much the same as coal, so we made her the proposition that we would install our Hughes type No. 33 stove for sixty-five dollars, same to be cash, and that we would agree to take this stove back any time within four months should the monthly bill exceed four dollars

Hughes Range No. 30 Average Family Size Made by Hughes Electric Heating Co., 211-33 W. Schiller St., Chicago, Ill.



Four Plate Range Made by Rutenber Electric Co., Logansport, Ind.

Simplex Range Made by Simplex Electric Heating Co., Cambridge, Mass.

Hughes Range No. 50 with Elevated Oven and Warming Closet Made by Hughes Electric Heating Co., 211-33 W. Schiller St., Chicago, Ill.

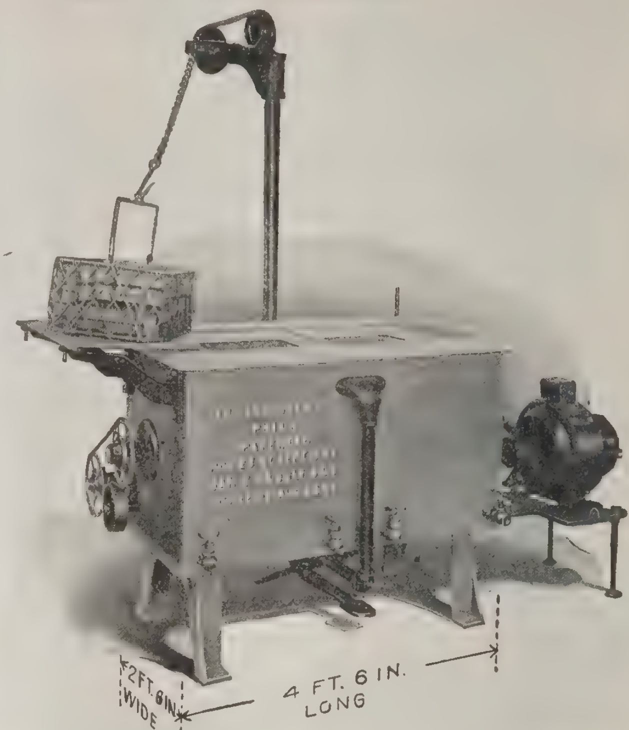
Electric Range Made by Central Electric Company, Schenectady, New York.

Hotel Range Made by Simplex Electric Heating Co., Cambridge, Mass.

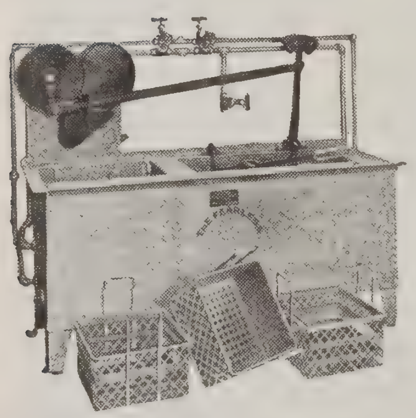
with electricity, and will consume about two Kw. hours; with coal, it will take about two and a half hours and will take not less than forty pounds of coal.

We have then, for an average day, a cost with electricity of 2½ Kw. at four cents, equals 10 cents, while to supply the same food with coal would take seventy pounds of coal, which at four dollars per ton would have cost fourteen cents, or, in other words, electricity at four cents will be as cheap as coal at two dollars eighty-five cents per ton. Similarly, electricity at four cents can be shown to equal artificial gas at one dollar thirty-five cents. This leaves only two forms of cooking which are cheaper than electricity, or enough cheaper to make this a decisive point. They are, first, natural gas, and second, gasoline; and against the latter of these we have the item of danger of explosion, which in most cases can be made to offset the saving. The above figures which have so far checked nicely with the operation of the electric stoves which we have out. Of course, where the family is more than five (which is the law in Missouri), or where a great deal of fancy cooking is done between meals, the bills for electricity, coal or gas will all be proportionately bigger.

Under this guarantee proposition we then proceeded to work on stove prospects, and by the end of September, 1914, we had some twenty stoves in use, all giving satisfaction. At that time the equipment of the new Domestic Science department came up before the Board of Education. The board was about evenly divided between coke and gas stoves.



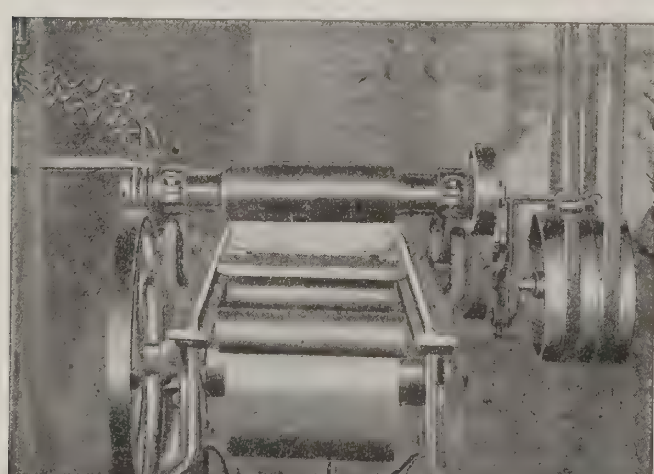
Electrical Dishwasher Made by Insinger Company, Philadelphia, Pa.



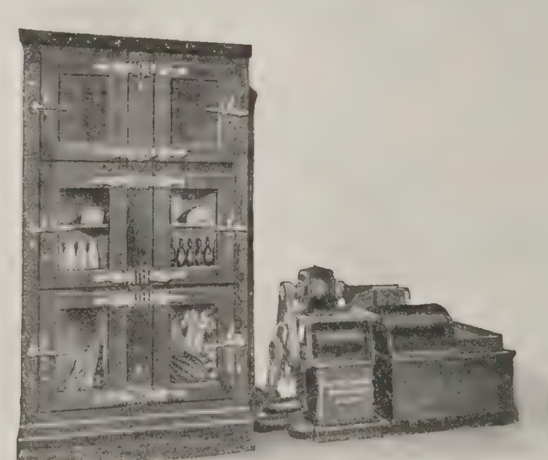
Electrically Operated Dishwasher Made by Fearless Dishwasher Co., 175-9 Colvin St., Rochester, N. Y.

Electric Dishwasher Handled by Western Electric Co., New York City.

Electric Vibrator Made by Lindstrom-Smith Co., Chicago, Ill.



Electric Rolls for Laundry Machines Made by Simplex Electric Heating Co., Cambridge, Mass.



Small Refrigerating Machines Made by H. W. Johns-Manville Co., New York City.

Some Special Devices that Possess Merits Worthy of Special Sales Work by Dealers and Central Stations.

without any one but the superintendent of buildings in favor of electricity. We felt that we just had to have this business—but how to get it?

We tried to talk the Domestic Science teacher into recommending electric stoves, but to no avail. Finally we got them to consent to come in and look at our stoves before buying coke or gasoline ranges. The Domestic Science teacher rang up at 2 p. m. one day, and told us that three members of the board, the principal of the schools and herself, would be down at 5 o'clock to look at our stoves. We at once got busy and fitted my office up as a dining room by covering the table with a cloth and borrowing the necessary utensils. We then connected up one of our stock stoves which stood out in the display room in front and arranged five chairs in a semi-circle about six feet from the stove. The educators came promptly at 5, and at our request were seated around the stove. I explained to them that we wanted them to see how easy it was for even some second rate electricians to cook on an electric stove. We then proceeded to cook a dinner, consisting of broiled steak, asparagus on toast, fried corn, Southern style, hot biscuits, mashed potatoes and coffee, all right before their eyes, and, as it were, with our sleeves rolled up so as to show that we had nothing concealed. At ten minutes to six, or just fifty minutes after they had entered and less than forty minutes after I first turned on the current, we served them one of as good meals as they ever sat down to. That night when the stove question was brought up, the board voted unanimously to buy nine electric stoves for the High School. These stoves now pay us from forty to fifty dollars per month revenue.

Soon after this incident we made another advance in selling stoves. It happened that a man wanted some charging cable, "about five hundred feet," he said, and requested us to order it. We did, but before it came he decided that he only needed one hundred feet. We called his attention to the fact that this was "special," but he refused to accept any more than the one hundred feet. Finally, therefore, we gave in, and billing him enough to pay for the entire five five hundred feet, shouldered our loss and put the remaining four hundred feet in stock. There it had lain for nearly a year when the bright idea hit us. Why not use this for stove demonstrations? It was No. 8 wire, well enough insulated to be strung over a tree limb around the corner of a house and over the window sill into the kitchen, and could be put up or taken down in less than an hour with scarcely any damage to the wire. We now have by means of this charging cable, a method of installing our stoves on trial, with only slightly more cost than that of placing an iron or a vacuum cleaner.

"Many possible users of central-station service are simply waiting to be shown when they will adopt the electrict range as a modern cook-stove," says the N. E. L. A merchandising committee in its report. As an indication of the possibilities and methods to use in the sale of the entire range, the following illustration is given: One central station sold nearly seventy ranges of a standard size in an easy-payment trial campaign. Payments were $6.00 down and $6.00 a month for nine months on a special cooking and heating rate, the customer paying for the necessary wiring from the meter to the range; the range remaining the property of the central station until paid for and any payments retained by the company to defray the expense of restoring the range to salable condition if returned. The rate for the electric service was 10 cents a kilowatt-hour for the first kilowatt-hours and 3 cents a kilowatt-hour thereafter. No range was returned and many letters of appreciation were written voluntarily to the company.

As an example of the possibilities with vacuum cleaners, reference may be made to the sale of 850, 425 and 350 cleaners during January, March and June of last year in the city of Toledo, Ohio, by the central station. During the entire year an average of five of these devices was sold per day. This business was secured through circular letters and solicitors who worked individual territory.

The Christmas campaigns conducted by the H. M. Byllesby properties last year in cooperation with electric dealers, resulted in the sale of 15,400 lamp socket appliances representing a connected load of 6,800 Kw. One of these properties, the Louisville Gas and Electric Co., of Louisville, Ky., sold during 1914 some 3,870 appliances. The towns and cities in which this company operates are not different from others so that these results are fair indications of the possibilities and profits from the right sort of sales work by dealers and central stations.

New Apparatus and Appliances

Small Tungsten Lamps with Concentrated Filaments.

The distinctive features of the concentrated filament tungsten lamps of high wattages have proved so popular that the Edison Lamp Works of the General Electric Company has developed vacuum tungsten lamps of similar appearance in the 25, 40 and 60 watt sizes. This concentrated filament construction gives greater vertical distribution of light downward than the regular tungsten lamps of corresponding wattages. The new lamps will, therefore, be employed where natural distribution of light downward is required. They can be used in existing sockets and fixtures, and will be made in the same sized bulbs as the corresponding regular tungsten lamps, will have the same spherical watts per candlepower efficiency and a rated average life of 600 hours.

Tungsten lamps of the same size and characteristics have also been added to the line of the Westinghouse Lamp Company.

A New Ground Clamp.

A ground clamp consisting of two strips of brass, of different gauge and width with the longer strip formed at the end with a punched lug, through which the brass clamping screw extends, is shown in Fig. 1. When assembled the hook end of the longer strip is extended through a slot in the opposite end and into the eyelet in the second strip forming a band which fits loosely around the pipe or conduit to be ground. The shorter strip attached to the end of the first strip, is then bent around until the punched lugs are in line, permitting the clamping screw to be placed

in position. As the screw is tightened, drawing the ends together, the shorter strip draws the narrowed end of the other through the slot, thus reducing the circumference of the band until it is tightened on the pipe or conduit.

This clamp closes perfectly round over the pipe allowing absolutely no opportunity for the slightest leakage of current, thereby insuring a perfect ground on its entire circumference. It will not buckle and can be easily slipped

The Ideal Ground Clamp.

over a pipe, in any position and will always maintain its original shape. To install the clamp, the inner piece is slipped over the pipe into position. This piece is then slipped in the lip of the inner piece and fastened with brass screw and nut. These clamps are made of brass 5/8 and 7/8 inches wide and in gauges No. 20, 18 and 16. This ground clamp is being placed on the market by Frederick Rall, 19 Park Place, New York City.

New Robbins and Myers A. C. Ceiling Fan.

A new design of alternating current ceiling fan has been announced by the Robbins and Myers Company of Springfield, Ohio. This fan is equipped with a self-starting, shaded pole type induction motor in which the field coils are securely attached to the laminated steel core and thoroughly insulated from it. The rotor is built up of electrical sheet steel laminations with copper conductors securely riveted to the copper end rings. Ball bearings are used.

The fan has four blades with a sweep of 54 inches in diameter. It has a 3-point, two speed switch and regulator, the switch serving to start and stop the fan as well as regulate its running speed. The fixture bar has four plugged holes suitable for 3/8 inch brass fixture pipe connection and the customer can readily wire the motor and attach electrical fittings for lights when desired. The fan motor operates on 110 and 220 volt, 60 cycles.

Electric Signals for Automobiles.

An ingenious electrical signaling device has been patented by Mr. William M. Voss, of Tampa, Florida, which is designed to announce changes in direction of a moving vehicle and stops. The device consists in the main of solonoid operated annunciators, the setting of which indicates to the oncoming driver the intention of the driver ahead, which indication is called to the attention of the oncoming driver by a horn or other audible signal. The apparatus is intended for mounting at the rear of the automobile in plain view of oncoming drivers. This device should be an aid in reducing rear end collisions and preventing other accidents in crowded streets.

A New Line of Fans.

A new line of fans on which patents have been secured during the present year are being manufactured by the Allied Electric Company, 105 North Clark Street, Chicago. The fans are being placed on the market under the trade name of "Storm Wave," this name being descriptive of the air currents produced by the fan oscillating mechanism.

As shown in the accompanying illustration the feature of the fan oscillating mechanism is an arrangement that causes the fan blades to tilt up and down while oscillating back and forth or to tilt up and down when set in the non-oscillating position. Also the mechanism permits

New Robbins and Myers Ceiling Fan.

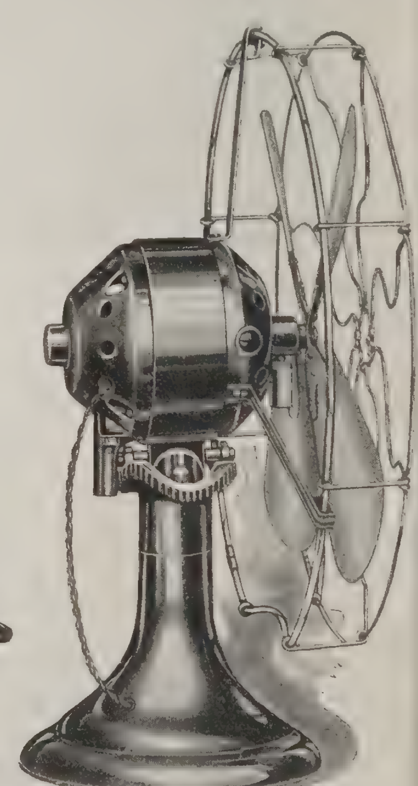


Fig. 1. Side View of Storm Wave Fan Show
Operating Mechanism.

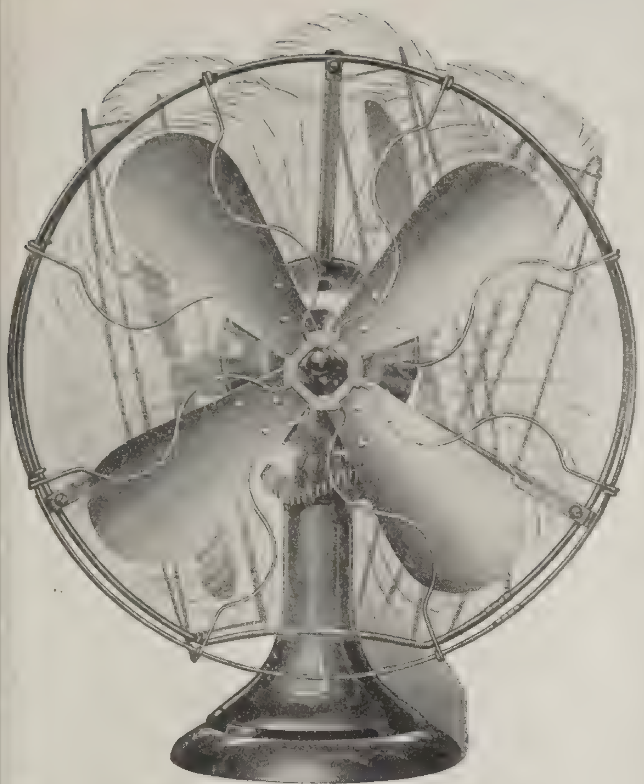


Fig. 2. Positions Possible With Storm Wave Desk Fan.

stationary operation the same as any non-oscillating fan and at any angle.

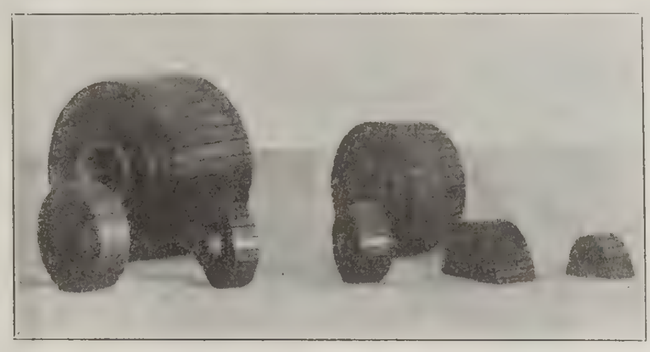
The fans are built in 12 and 16 inch sizes for desk and column use.

The Dale Broadway Lighting Unit.

The accompanying illustration shows a design of lighting unit made by the Dale Lighting Fixture Co., 107-109 West 13th Street, New York City. This is a standardized fixture adapted to various requirements by a simple fitting and interchangeable parts. The outer wires connect directly to the porcelain as shown in Fig. 2, eliminating the necessity of any insulating joint. The unit can be converted for semi-indirect or indirect lighting by the use of certain attachments. An adjustment is also provided in the unit to allow the use of lamps in sizes from 25 watts to 1000 watts. Over 13,000 of these units have been installed in the new Equitable building in New York City.

Bakelite Commutator Construction.

The Diehl Manufacturing Company of Elizabeth, New Jersey, is placing on the market a new and improved type of commutator in which Bakelite is used and manufactured under patent rights. Bakelite is a synthetic chemical compound, white and flakey in its raw state, but when subjected to great heat and pressure becomes exceedingly hard, having high mechanical and dielectric strength.



New Diehl Commutator Construction.

Commutators manufactured by the patented process from Bakelite, use bars of approximately the same shape as when constructed with mica rings. Very high peripheral speeds may be attained by commutators when the Bakelite method of construction is used. Mica of standard quality is used between the bars, but Bakelite fills up all space between bars and bushing and eliminates chance of short circuits or grounds.

Electric Ceiling and Porch Light.

The accompanying illustration shows a design of battery light that can be easily attached to the ceiling of a porch, closet or pantry, or placed on the wall. It is provided with a long string connected to the switch, by means of which the light can be turned on and off. It is claimed that the lamp will burn continuously on one ordinary dry cell for about 40 hours, or if used intermittently from six to twelve months. It is provided with a tungsten bulb and a large reflector and lens.

The switch on this lamp is of simple design and will not easily get out of order. The case is weather and fireproof. There is use for this lamp, even in the homes where the electric current is already installed, as in many closets and out of the way places.

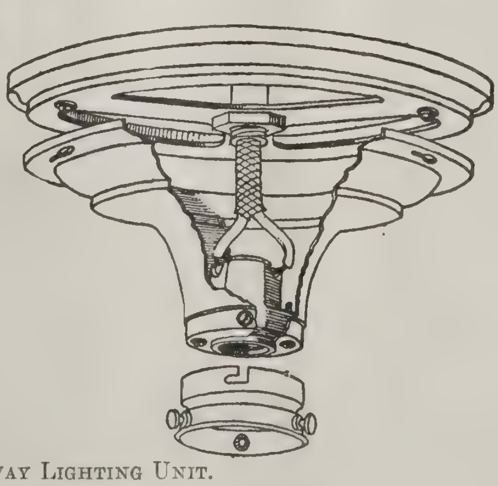
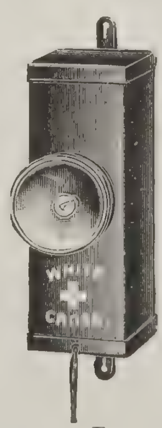


Fig. 1. The Dale Broadway Lighting Unit.
Fig. 2. Parts and Wiring Arrangements of Dale Lighting Unit.



A Battery Ceiling and Porch Light.

New Motor Driven Tools.

A combination of electric motor and flexible shaft for drilling, grinding, buffing, die sinking and screw driving has been recently designed and placed on the market by the Stow Manufacturing Company of Binghamton, N. Y.

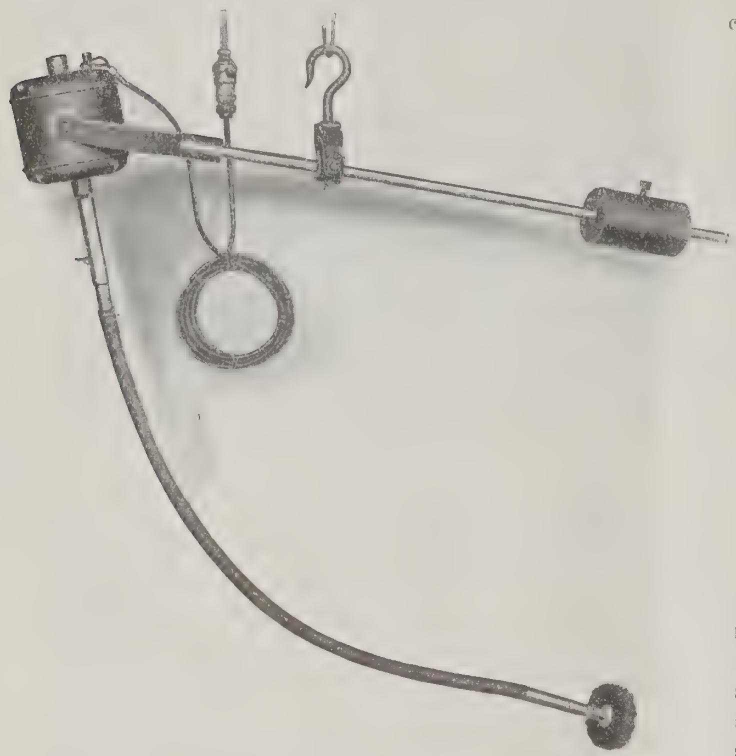


Fig. 1. Stow Suspended Type of Motor and Flexible Shaft.

In Fig. 1 a suspended type of direct connected motor and shaft combination is shown that can be operated from any alternating or direct current lamp socket. The design shown in Fig. 2 is known as a general utility tool and can be operated from a lamp socket. A speed of 400 to 7000 revolutions per minute can be secured for the different kinds of work mentioned above.

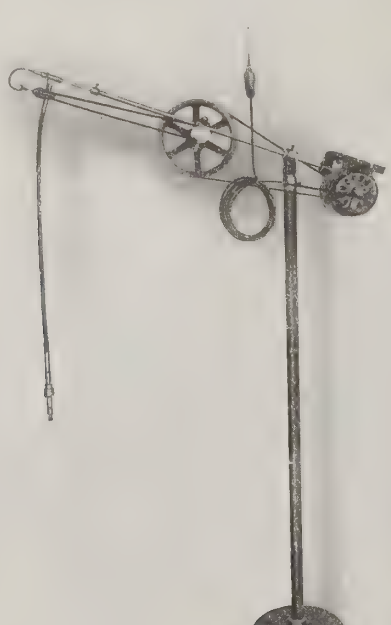
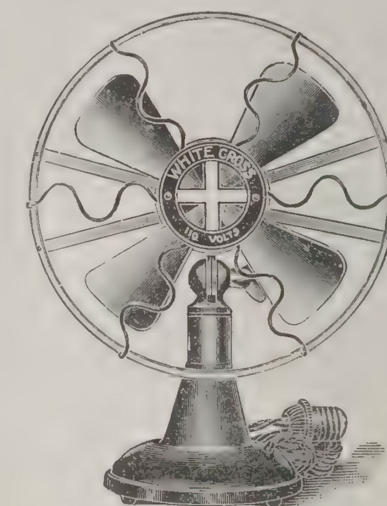


Fig. 2. The Stow General Utility Tool.

The White Cross Fan.

An inexpensive design of electric fan made by the Lindstrom Smith Company of Chicago, Ill., is shown in desk and wall type in the accompanying illustrations. This fan is listed as an 8-inch size yet weighs only six pounds. It is made to operate on direct or alternating current circuits of from 8 to 120 volts and any frequency. When



The White Cross Fan No. 62.

made in nickel or oxidized copper this fan has a very at tractive appearance and well suited for use in homes, office and telephone booths. The motor has a self-feeding oilin arrangement and is provided with a practical starting an speed regulating device mounted in the motor frame at th rear bearing.

New Trolley Frogs.

There are a great many designs of trolley frogs on th market and each has its good points. Some have advan tages over others in the straight under-run and flexibl approach features easy method of installation, and lon life under severe operating conditions. Some have the ad vantage of being designed in only one degree of angle t take care of all conditions regardless of the degree of curva ture of the track, necessitating the carrying of only tw styles of stock, that is, the right hand and left hand. Th latest development in this line is the Westinghouse frog shown in Fig. 1. This is a trolley frog without movabl parts that can be used with perfect success at points wher high speeds are obtained, the design being such that th trolley wheel does not travel on its flanges, and therefor no bump occurs when the bearing of the wheel is trans ferred from the groove to the flange. It is this bum that invariably dislodges the wheel from the wire.

A New Westinghouse Trolley Frog.

The illustrations show the new Westinghouse frog for a 15 degree angle designed for city service, however, the company is prepared to furnish this type of frog in either an 8 degree or 10 degree angle for high speed interurban service. The malleable iron frog has recently become popular on account of its long life as compared with the bronze frog, although a great many operating men prefer the latter on account of the longer life obtained from the trolley wheels. This argument does not apply to the malleable iron frog shown as the resistance to the passage of the trolley wheel is less than with any design of bronze frog. Therefore a wheel will give longer life operating under the type BR malleable iron frog because the flanges of the wheel never engage the frog body, practically eliminating the arcing at these points.

Trumbull Wall Push-Button Switch.

A new push-button switch designed by the Trumbull Electric Mfg. Co., Plainville, Conn., is shown in the accompanying illustration. It is claimed to have fewer parts than similar switches now on the market and is designed

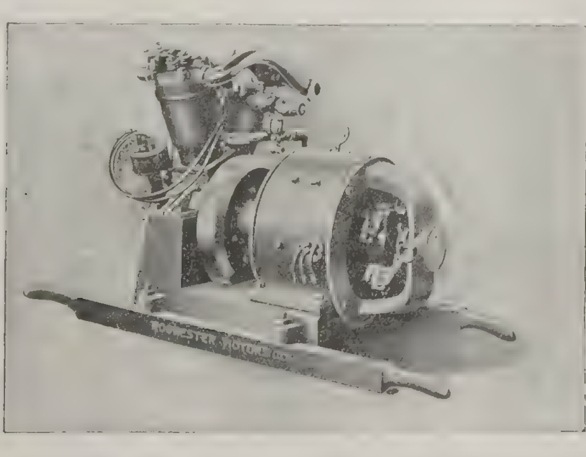
A New Trumbull Wall Switch.

to withstand an over load 50 per cent greater than most switches of this type. The simplicity of the mechanism is seen from the illustration.

A Small Portable Lighting Set.

The accompanying illustration shows a design of portable gasoline-electric set for use by contractors, in camps, by traveling shows, etc., as made by the Rochester Motors Company of Rochester, New York. This outfit is rated at 2 Kw., and weighs less than four hundred pounds. The generator is provided with ball bearings packed in nonfluid oil, there being but one oil cup in the entire outfit to keep filled with oil, all the lubrication being automatic.

A water cooling arrangement is shown on the design of Fig. 1, however, smaller outfits made use of air-cooled motors. Atwater-Kent ignition is used although either the

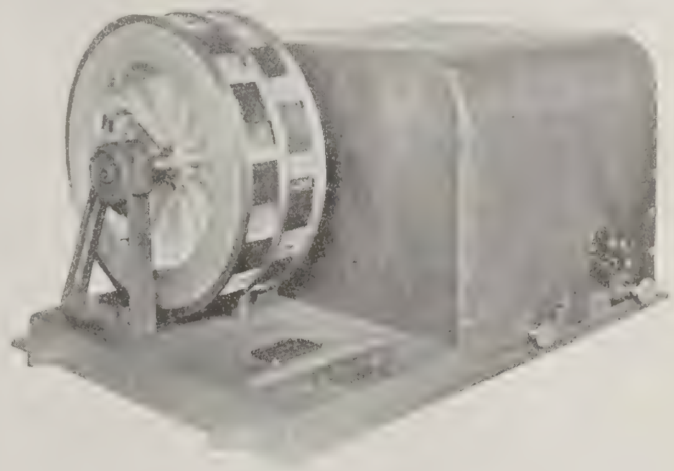


A New Portable Lighting Set.

air or water-cooled motor may be equipped with magnets instead. The generator can be wound for voltages of 32 to 250 however 68-volt outfits have been standardized and are carried in stock, this being the voltage most used by picture shows and docks where it is desired to operate both incandescent and arc lights.

The Denver Siren.

The accompanying illustration shows a motor driven device to create a distinctive sound for fire and general alarms. The siren is made up of an aluminum rotor which revolves inside a bronze stator, and when direct connected to a motor produces a sound when started that varies over a considerable range and can be heard a distance of about five miles.



The Denver Siren.

The motor and transmission are protected from the weather by a close-fitting metal hood. When installed on the top of some building near the telephone exchange, the power wires to the motor can run through the telephone office permitting the operator to turn in the alarm upon receipt of a telephone call. Other switches can be located at convenient points. This device is made by Hendrie and Bolthoff Mfg. & Supply Co., Denver, Colorado.

Electrical Construction News

This department is maintained for the benefit of contractors, dealers, manufacturers and consulting engineers.

ALABAMA.

CLANTON. It is understood that the city has granted a franchise to J. C. Hayes to construct and operate an electric lighting plant in this place.

GUNTERSVILLE. It is understood that plans are being made for the installation of an electric lighting plant.

LINCOLN. The Alabama Power Company has been granted a franchise to operate in Lincoln.

FLORIDA AND GEORGIA.

ST. PETERSBURG, FLA. The city is planning to construct an electric light plant and will vote on $150,000 bonds at an early date.

JEFFERSON, GA. The city of Jefferson will receive bids up to April 19th for hydraulic and mechanical equipment for a small power plant. Equipment consists of a 50 horsepower engine and 37½ Kw., 60 cycle generator with switchboard and equipment, together with motor driven pumps, Solomon-Norcross Co., of Atlanta, is in charge of the engineering.

PERRY, GA. It is understood that a water power is to be developed at Charpes Mill and a transmission line built to Perry. W. L. Henry is interested.

VALDOSTA, GA. It is understood that the South Georgia Power Company plans the construction of a hydro-electric plant on the

Withlacoochee River near Valdosta and transmit power to the cities of Valdosta, Thomasville, Quitman, Camilla and other nearby towns.

LOUISIANA AND MISSISSIPPI.

ABBEVILLE, LA.—It is understood that an ornamental street lighting installation is to be made, consisting of five lamp standards.

MANDEVILLE, LA. Plans are under way for an electric railroad to be operated between Mandeville and Covington. The road will be built by St. Tammany & New Orleans Railway Co., and Hal Raymond, of New Orleans, is Consulting Engineer.

HARRISBURG, MISS. The question of establishing municipal service is before the city commissioners

NORTH CAROLINA.

GIBSON. This city is planning to install a municipal electric lighting plant.

ST. PAUL. St. Paul Light & Power Co., is constructing a transmission line to serve a cotton mill and other additional lines to different parts of the town.

BLACKVILLE. City is planning to make improvements to the municipal electric lighting plant.

LAWBERN. The Lawbern Street Railway Co., is about to change its equipment from storage battery cars to a trolley system.

LEAKSVILLE. The Leaksville Light & Power Co., plan to buy a 60 Kw. and 100 Kw., 60 cycle generators and exciters together with a street lighting equipment.

MAXTON. The Carolina Electric Company is constructing a power house at Whiteville, N. C., and will build a transmission line.

MORGANTOWN. Plans have been prepared for the construction of a dam and power house to develop 6,000 Hp. on the Catawba River and 400 Hp. on the Henry River. The power generated at these points will be transmitted to Morgantown, Drescel, Valdese and Connolly Springs. H. L. Millner is engineer.

OXFORD. The Carolina Power and Light Co., has recently completed a 60,000 volt transmission line from Oxford to Roxboro to supply current to cotton mills and the city.

SOUTH CAROLINA.

UNION, S. C. The municipal electric light and waterworks, of Union, S. C., is to extend water mains to another creek for additional water supply, and erect 6,600 volt, three-phase transmission line to supply power for operating motor driven pumps. $25,000.00 is available for this work. R. A. Easterling is superintendent of the plant and has charge of construction and engineering.

PERSONALS.

MR. WILLIAM SIEBENMORGAN, has resigned as chief engineer of the C. & C. Electric & Mfg. Co., of Garwood, N. J.

MR. J. E. MAIR, sales engineer with the Appleton Electric Company of Chicago, and well known among the trade as a genuinely enthusiastic booster of "Unilets," is making a trip through the South. Mr. Mair when seen in Atlanta, reported an optimistic feeling among jobbers and found them stocking goods in a fairly liberal way. While new construction work is not generally in evidence, he said signs of activity that will develop into such could be seen and that electrical jobbers and dealers were preparing to handle it as soon as conditions became favorable. Mr. Mair left Atlanta for Southern Georgia, Florida, Alabama, Lousiana, Texas, Arkansas and Oklahoma, expecting to return to Chicago early in June.

W. S. THOMAS, treasurer of the Wagner Electric Manufacturing Company of St. Louis, has been elected as a vice-president. WALTER ROBBINS, for many years assistant general manager of the Wagner Electric Manufacturing Company, has also been elected a vice-president.

MR. H. J. HERBERTS, after an absence abroad of some 15 years has returned to this country to take up special work in connection with his various inventions. Mr. Herberts has had an extensive operating experience both in this country and abroad, and plans to organize manufacturing and selling forces in the United States and Canada for the exploitation of current consuming devices. A laboratory and factory will probably be established at Los Angeles, Calif.

MR. J. C. DALEY, electrical and designing engineer for the Thordarson Electric Mfg. Company, Chicago, has severed his connections with that company and joined with Mr. J. A. Bennan and Mr. A. R. Johnson in the incorporation of the Jefferson Electric Mfg. Company. The new company is already located and doing business at 847-851 W. Harrison Street, Chicago, manufacturing a complete line of toy, bellringing, sign lighting and welding transformers, battery switches, steel battery box outfits, make and break and jump spark ignition coils, and a line of high tension transformers for testing, laboratory and research work.

THE ADAMS-BAGNALL ELECTRIC CO., Cleveland, Ohio, announces the opening of a sales office March 15th at No. 417 South Dearborn St., Chicago, Ill. This office will be in charge of Mr. Van N. Marker, who has long been identified with the company in the Northwestern territory.

INDUSTRIAL ITEMS.

USONA MANUFACTURING COMPANY, Inc., recently incorporated in the states of New York and Ohio, have opened Eastern offices at No. 1 Hudson Street, New York City, with Western offices at 309 S. St. Claire Street, Toledo, Ohio. An extensive line of high grade flashlight cases, battery lanterns, batteries and miniature lamps will be made under the name of "Kwik-Lite." The company announces that exclusive rights to the well known Beers lantern have been secured and it will be added to the Kwik-Lite line.

Mr. George G. Beers will be in charge of the New York office, and Mr. Frank Stout, formerly with the Bryant Electric Company, will be sales manager.

MR. E. E. ESLINGER, principal owner and manager of the Central Electric Co. of Hattiesburg, Miss., has sold his stock in the company to Mr. E. B. Conn formerly electrical engineer with the Wells Lumber Co., of Lumberton, Miss. Mr. Eslinger has been in Hattiesburg for five years. For two years he was superintendent of the Hattiesburg Traction Company, and for the last three years has been in the general electrical contracting business. He will return to Huntsville, Ala., where he will engage in business with his father, W. W. Eslinger, who is a stock raiser and interested in a number of country mercantile establishments.

THE TERRY STEAM TURBINE CO., of Hartford, Conn., announces that after March 22nd the Chicago office will be in charge of Mr. A. W. de Revere, and located in the Peoples Gas Building. An office has also been opened in the Michigan Trust Building, Grand Rapids, Michigan, in charge of Mr. A. L. Searles, to cover the southern peninsula of Michigan.

THE ROBBINS AND MYERS CO., of Springfield, Ohio, reports good business during the early part of this year with orders on hand compelling the operation of several departments over-time.

THE SOUTHPORT LIGHT & POWER CO., of Southport, N. C., will be sold at public auction on April 15th. New capital is necessary to place the plant on the footing required by the additional business. The corporation is composed of local business men who subscribed for stock from civic pride. The moving spirit is now compelled thru illness to retire and the property will be sold in the hope that someone with experience and capital will secure it and continue the operation. It is a growing concern and the city has just signed contracts for water and sewer systems, the power for which will be furnished from the plant. There is an ice plant in connection with the central station, which will also go to the successful bidder.

Bind in letter in place of #5

WM. R. GREGORY CO.

BAKERS REVIEW – FEEDINGSTUFFS

WOOLWORTH BUILDING
NEW YORK

THOMPSON, PRESIDENT

April 17th 1920

The University of Illinois Library,

Urbana, Ill.

Attention of [redacted].

Gentlemen:

Replying to your letter of March 30th just received, requesting a copy of the May 1915 issue of Electrical Engineering to complete your files, we very much regret we are unable to furnish this, as we sold this publication in 1918, and did not retain any of the old copies.

The paper has again been sold since that time, hence we very much doubt whether you would be able to obtain a copy at least five years old from the new publisher. In fact this paper is now absorbed by another publication.

Regretting our inability to be of service to you at this time, we are,

Yours very truly,

WM. R. GREGORY COMPANY.

A. S.

AS*EK

217

This Issue 9,000 Copies

ELECTRICAL ENGINEERING

Vol. 47. JUNE 1915. No. 6

Transmission and Distribution System of Alabama Power Company

AN example of a high voltage transmission system embodying recent advances in engineering and a layout which is the result of a careful study of other existing systems, is the recently completed 110,000 volt system of the Alabama Power Company. The 105,000 horsepower hydroelectric generating station of this company at Lock 12 on the Coosa River was described in the March issue of *Electrical Engineering,* while the reserve steam plant which was used to serve the customers while the Lock 12 plant was being erected was reviewed in the January, 1914, issue.

As seen from Fig. 1, the principal industrial districts of Alabama are served by the high tension lines of the company. The importance of continuity of service to these industries and cities has dictated the policy of the company in building the transmission lines in the most conservative and latest approved methods of stable construction. Of this 110,000 volt system, 92 miles is double circuit and 94 miles single circuit. To serve these scattered industries and deliver large amounts of power to points somewhat distant from the source of generation, a high voltage was required for economical transmission. After careful study 110,000 volts was decided upon, permitting the serving of distant customers with a reasonable size of conductor and with a reasonable loss. It is a voltage that has been in use several years and the transformers and switching apparatus for it have been well tried out and have proven reliable.

Freedom from corona loss for that voltage requires a conductor of the size of No. 00 copper determining the smallest size advisable. The limit of the oil break switches at the present time is approximately 25,000 Kw. and the loss in 100 miles of single circuit No. 00 copper at 110,000 volts and ordinary power factor is about 12 per cent, so that No. 00 medium hard drawn copper was chosen for the high voltage transmission line conductors. It was decided to string the conductors at such a tension that under the severe weather conditions for Alabama of 0 degrees temperature and ¼ inch of ice coating the wire and a wind blowing at the rate of 70 miles an hour, a strain of only one-half of the ultimate strength of the cables would be produced.

These lines are supported on double circuit steel towers of the four-legged windmill type of American Bridge Company's design. The average weight is 4,700 pounds. The use of flexible towers of the single A frame type was considered, designed to withstand the side stress due to wind, etc., at angles with the line, relying upon the conductors and ground wire to support the structures in the direction of the line. The breaking of a single conductor under conditions of maximum tension would therefore throw excessive strains in the remaining lines and it is quite possible that if one wire should break under these conditions all of the other wires would break. To overcome this feature, it was found necessary to allow greater factors of safety in the stringing, resulting in greater sag of the conductors for the same tower spacing and consequently higher towers.

This type has been used with success by other companies on low tension lines with pin insulators, and an order of them was put in for one of the distributing lines, but in spite of the apparent saving in first cost it was decided not to sacrifice the greater reliability of the four-legged structure for this consideration.

The height from the earth to the lowest cross arm was made sufficient to use the towers on a spacing of approximately of 750 feet and yet have a clearance above ground in the center of the span of 25 feet. Careful study of the experience of other transmission companies using 110,000 volts indicated an advisable vertical distance between cross arms of 10 feet and a horizontal spacing between circuits of approximately 15 feet. Even with these spacings, some companies have had trouble with short circuits caused by the whipping up of single unloaded conductors into the

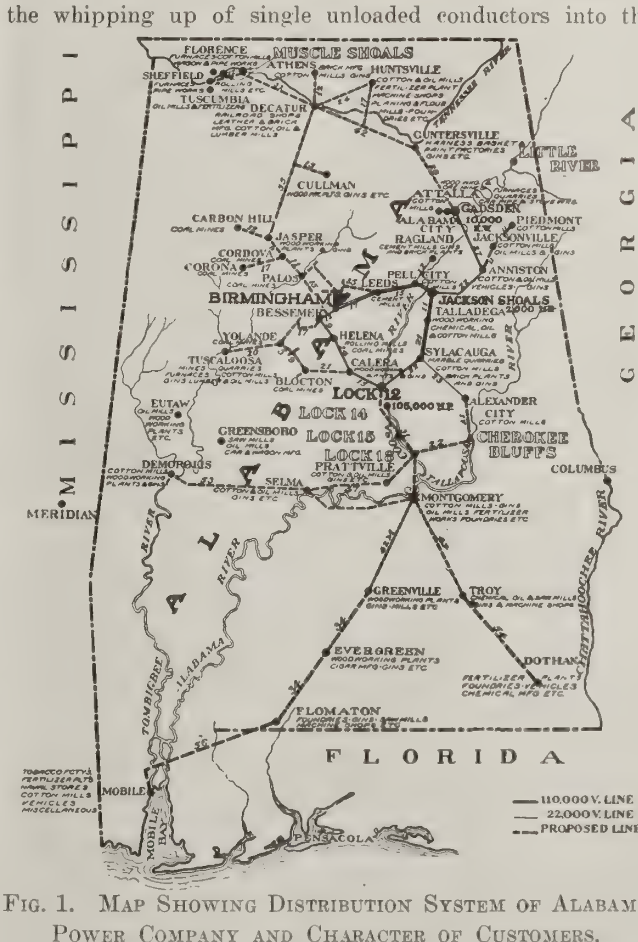


Fig. 1. Map Showing Distribution System of Alabama Power Company and Character of Customers.

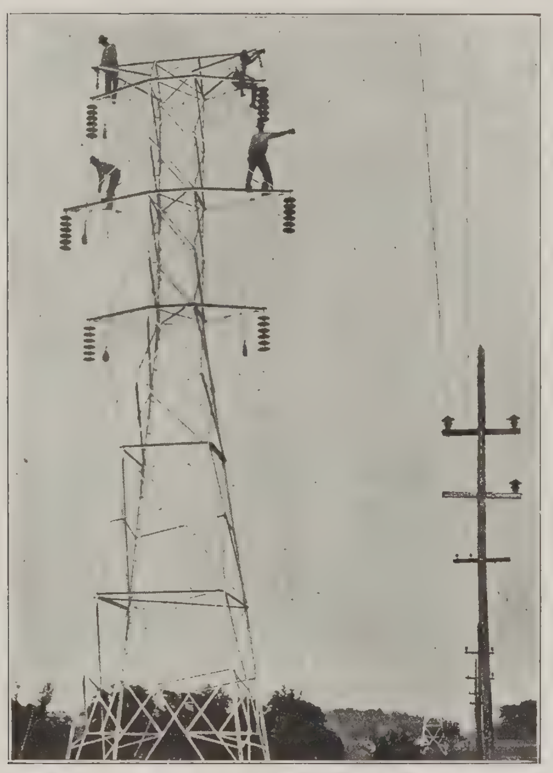


FIG. 2. TYPE OF TOWER USED ON 110,000 LINES.

other conductors in the same span when they were ice laden. A simple and economical way of avoiding this was accomplished by making the middle arm somewhat longer than the other two, as shown in Fig. 2.

These towers were made almost exclusively of steel angles galvanized after being cut and punched and all bolts used were sherardized to prevent rusting. The legs were bolted to stubs of a somewhat heavier section which extended into the ground about 7½ feet and which had grillages of galvanized angle about 7 square feet in effective area at the end of the stub. In all cases of soggy or soft ground the hole was filled with a foundation of field stones before the anchor was placed and then covered with field stones before tamping. All footings were carefully tamped in so as to make the fill as compact as possible. In case of hard rock, a special anchor was grouted into a drill hole and the lower legs bolted to this. Only at severe angles, dead end towers and for exceptionally long spans was concrete used. For crossings where the wires had to clear the navigable rivers by 65 feet, necessitating special towers, reinforced concrete bases were used.

Six disc strings of the 10 inch corrugated and the 12 inch flat insulators were used on suspension and seven of these discs at the strain points. An extra disc per string is being added to increase the factor of safety of these strings on account of the unevenness of matching the units in the strings.

The lightning storms of Alabama are particularly severe. To guard against interruption from this source, two steel wires grounded directly at each tower have been installed over the transmission conductors. No plates or rods driven into the earth were needed to procure a good conducting medium to care for the lightning discharges as the large area of steel grillages in the fairly moist earth proved of relatively low resistance. Further at each substation electrolytic lightning arresters are installed.

DISTRIBUTION LINES.

The standard voltage of 22,000 was adapted for distribution lines. This value is high enough to allow the delivery of large amounts of power and yet gives only slightly increased costs for customers' transformers and switching apparatus. As seen in Fig. 1, there are about 163 miles of these lines of which 73 miles are on steel towers and of 2/0 copper. The balance are wood pole lines. The standard type of construction uses creosoted long leaf yellow pine poles with either creosoted or metal cross arms with 35,000 volt pin type insulators. One steel ground wire is carried above the line on a metal bayonet. This steel wire is grounded at every third pole. No. 4 copper is the smallest size of conductor used for reasons of mechanical strength, but the copper size for heavier loads is determined entirely by the economical loss allowable. Throughout all the work, special structures have been avoided wherever possible and were only used where such conditions as extra large clearance over navigable rivers made it necessary.

SUBSTATIONS OF THE ALABAMA POWER COMPANY.

After a careful study of the various types of outdoor substations, it was decided to use an outdoor structure of towers and girders as such a construction admitted of cheaper extensions and required less steel work than the type with the larger number of individual towers or supports. Furthermore, the adopted construction has proven extremely rigid and probably less liable to suffer damage from high winds or other extraordinary loads. With the exception of the substation at the generating plant at Lock 12 on the Coosa River, where the conditions were not favorable for the outdoor type, all of the 110,000 volt transformers, switches and lightning arresters of the Alabama Power Company are of the outdoor type, and there is installed under cover only the switchboard, low tension switches and other similar apparatus.

Near Gadsden, Ala., is located one of the reserve steam plants of the system, generating at 2,300 volts. Service to the surrounding industrial district and to the city of Gadsden, makes it necessary to distribute from the station

FIG. 3. TYPES OF WOOD POLE LINE CONSTRUCTION.

at 22,000 volts, while the incoming transmission lines operate at 110,000 volts. These conditions of three voltages were met by the use of specially designed transformers each having three separate windings for delivery of either 2,300, 22,000 or 110,000 volts. Such an arrangement allows the delivery of steam power from the Gadsden plant into the 22,000 volt distribution lines or the 110,000 volt system, or the stepping down of the 110,000 volt power for use in the distribution lines and the station by using the same transformers.

This was the first substation designed, but in essential particulars it is typical. The outdoor steel work consists of two bays—one to care for the switching of either or both of the two incoming high voltage lines to either of the busses and the other for switching either or both of the two banks of transformers on either of the two busses. The low tension steel work varies in design in each of the stations to meet the particular requirements of the service. The switchboard and remote control are installed in the generating station at a distance of about 600 feet from the substation, the 2,300 volt power cables and control wiring being carried underground from this station.

Each of the seven transformers (one being a spare) are of 2,100 Kva. capacity, single phase, oil insulated and water cooled. The water from the river nearby, at times carries much sediment, so it was deemed advisable to throw up an earth dam in a nearby hollow to form a settling basin for the transformer cooling water, thus obviating any trouble from precipitation in the coils. The pumps are arranged to draw the water either from the river or from this basin, or to pump river water into this reservoir.

The 110,000 volt bushings on these transformers and the outdoor solenoid operated switches are of the oil filled type with large porcelain petticoats to exclude moisture. Ample provision for repairing the transformers and switches is made. The transformers are set on wheels so that they may be run off the concrete foundations onto a transfer truck and drawn into the repair house where a 30-ton hand operated crane is available for use. An oil piping system with two storage tanks and connections to each of the seven transformers makes it possible to drain any of the transformers, filter the oil and refill it without removing the transformer from its setting.

For protection against the severe lightning storms which are common in Alabama, all of the 110,000 volt and 22,000 volt lines are provided with electrolytic lightning arresters in addition to the overhead ground wires along the lines.

ANNISTON SUBSTATION.

The Anniston substation of 6,500 Kva. is located just outside the city limits, and somewhat similar to the Gadsden substation. It has three bays of steel work to care for the two double circuit lines coming into the station from Jackson Shoals and Gadsden stations and for selective bus connection to the transformer bank. The present installation consists of three 2,000 Kva. single-phase, oil-insulated, self-cooled transformers, connected in delta on both high and low tension so that any one of the transformers may be disconnected for repairs and the other

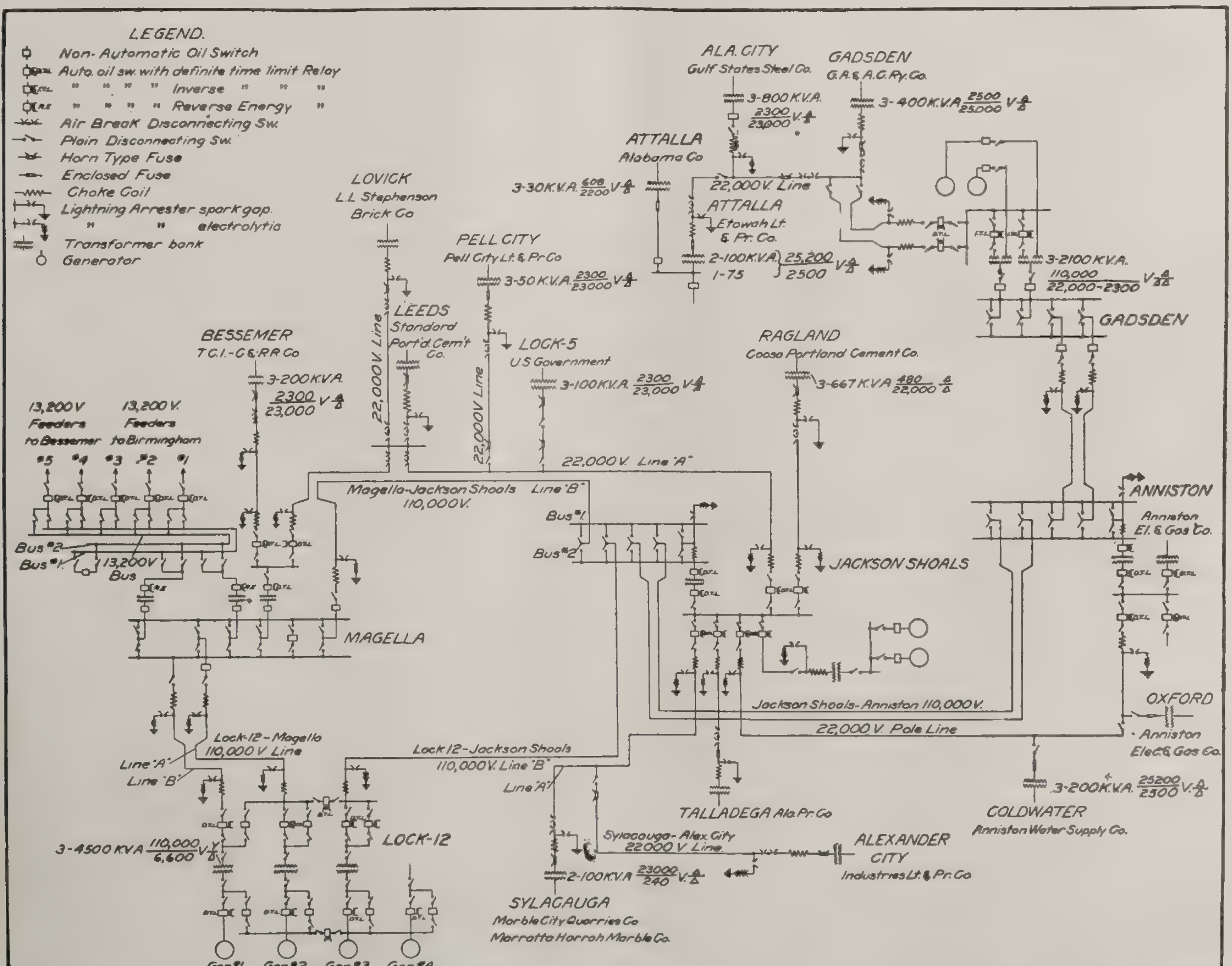


FIG. 4. LAYOUT OF GENERATING STATIONS AND SUBSTATIONS OF ALABAMA POWER COMPANY'S SYSTEM.

FIG. 5. SUBSTATION AT GADSDEN STEAM PLANT SHOWING 110,000 VOLT LINES ON RIGHT AND 22,000 VOLT LINES ON LEFT.

two continue to carry the load in open delta. These transformers are the largest of the so-called tubular type in the South.

The brick and steel switchhouse is comparatively large to accommodate the installation of a 2,000 Kva. bank of 22,000 volt to 2,300 volt transformers for service to the city and a 300 Kva. motor generator set for the local railway system. The arrangement for transformer repair and other features of construction are essentially similar to the Gadsden station.

JACKSON SHOALS SUBSTATION.

Jackson Shoals is an important switching point on the system. The double circuit high voltage line from Anniston, and the two single circuit lines from Lock 12 and from Birmingham come into this station. Furthermore, it is a distributing center for the 22,000 volt lines to Anniston, to Talladega, to Alexander City via Sylacauga, to Ragland, and to Leeds and to Birmingham. The bus structure is of the same type as that of Anniston. A bank of three 2,000 Kva. oil-insulated water-cooled transformers, connected delta, is installed with the same switching arrangements as in the other substations.

A low head (26 feet) hydro-electric plant of 2,000 Kva. capacity was built here before the 110,000 volt substation was built. The current from the hydro-electric plant is stepped up from 2,300 volts to 22,000 volts by three 667 Kva. transformers. In this power house is located the control switch panels of the substation which is about 500 feet away. As in the other substations electrolytic lightning arresters are provided on the 110,000 volt and 22,000 volt lines.

MAGELLA SUBSTATION AT BIRMINGHAM, ALA.

To supply the Birmingham Railway, Light & Power Company and other power users in the industrial district

FIG. 6. SUBSTATION AT ANNISTON OF 6,000 KVA. CAPACITY.

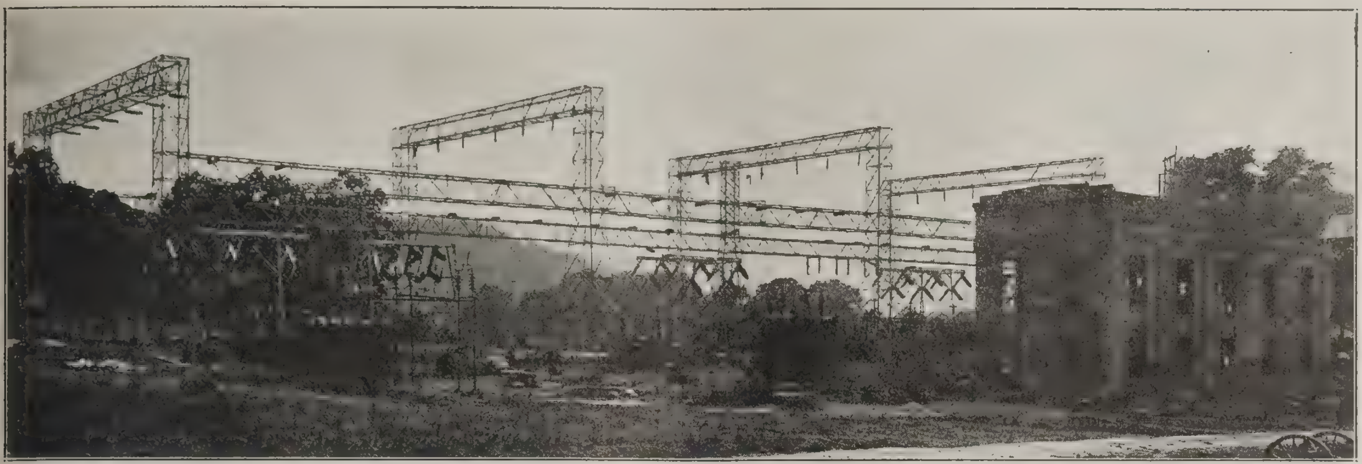


Fig. 8. The Magella Substation Near Birmingham, Alabama.

having Birmingham as its center, a 40,500 Kva. substation has been built just outside the Birmingham city limits. The steel high tension bus and switching structure is approximately the same as in the other stations, but the transformers are all 4,500 Kva. capacity. They are single-phase oil-insulated and water-cooled, connected in Y on the high tension side and delta on the low. Arrangements for a spare transformer are made as in the Gadsden substation.

Service to the Birmingham Railway, Light & Power Company requires the delivery of 13,500 volts while the standard power distribution voltage is 22,000 volts. This necessitates the use of separate banks of transformers and a complete duplication of the low tension busses and switches for each voltage. The 13,500 volt apparatus is housed in the steel and brick building which is arranged with the switchboard and switches on the upper floor and with the storage battery, store rooms and work rooms on the ground level. The cooling water for the transformers is obtained from wells. It is pumped from these wells into the cooling reservoir and from there through the cooling coils back into the reservoir through spray nozzles.

At Lock 12 the transformers and switching apparatus is entirely indoors with the lightning arresters and connections to the outgoing lines on the roof. A complete description of this 105,000 horsepower hydro-electric generating station and substation appeared in the January, 1915, issue of *Electrical Engineering.*

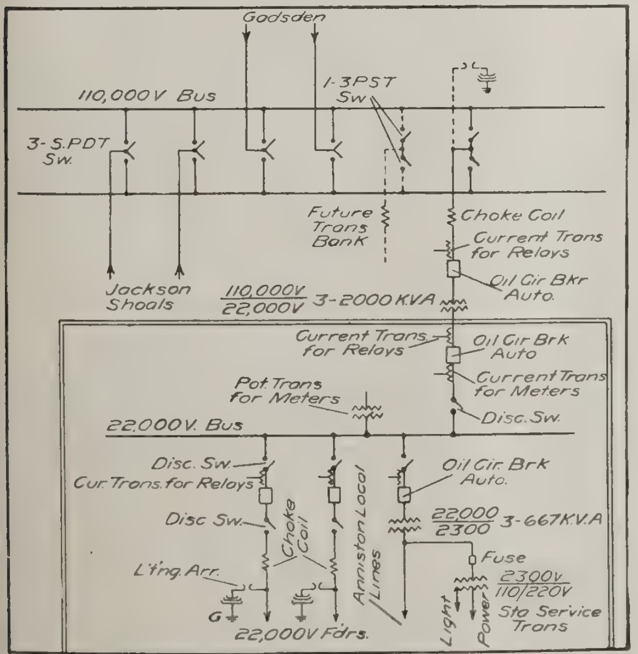


Fig. 7. Diagram of Circuits for Anniston Substation.

CUSTOMERS' SUBSTATIONS.

The arrangement of several of the customers' substations is novel and worthy of mention. In many cases it was impossible to build only a small switching structure for mounting the air break switches and horn gap lightning arresters and fuses and the transformers and switchboard were set inside the existing buildings.

At Alexander City a typical substation of 900 Kva. capacity was built. The switching structure is of steel framework, the transformers of the outdoor type and the switchboard and busses installed in the adjoining small brick house. Such construction makes a permanent, compact and eminently satisfactory arrangement at a reason-

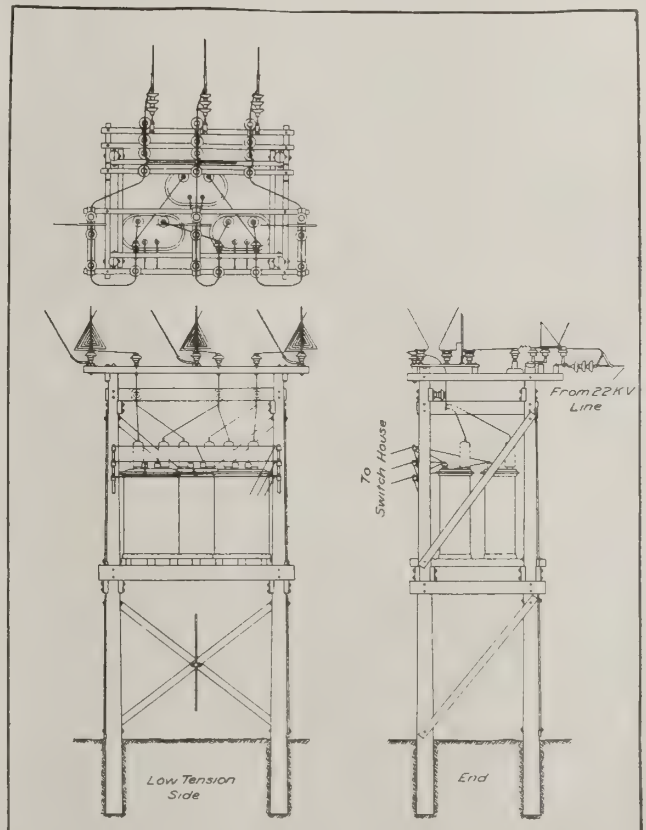


Fig. 10. A Typical Substation Design for 200 Kva and under at Pell City, Ala.

able cost. The neat and well balanced appearance pleases the eye and makes it possible to install this substation near the center of the load without objection from other property owners.

A typical installation for a smaller customer is the substation at Pell City where the transformers are mounted on a platform hung between the two poles caring for the incoming and outgoing lines. The high-tension switching apparatus is all mounted on one pole and the low tension leads are dropped from the other into the substation brick structure containing a suitable panel and measuring instruments. Single-phase transformers have been used in all of the customers' substations on account of the insurance given by the possibility of operating two of the three transformers in open delta and also because of the smaller weight of each of the single-phase transformers. These advantages overbalance the cheaper price of the three-phase type.

It is seen that for installations of less than 200 Kva. the transformers are mounted on platforms approximately 12 feet above ground while with the larger sizes the transformers are placed on the ground. This outdoor type is considerably cheaper than the necessary housing and the indoor apparatus of the same capacity and has been adopted as a standard construction.

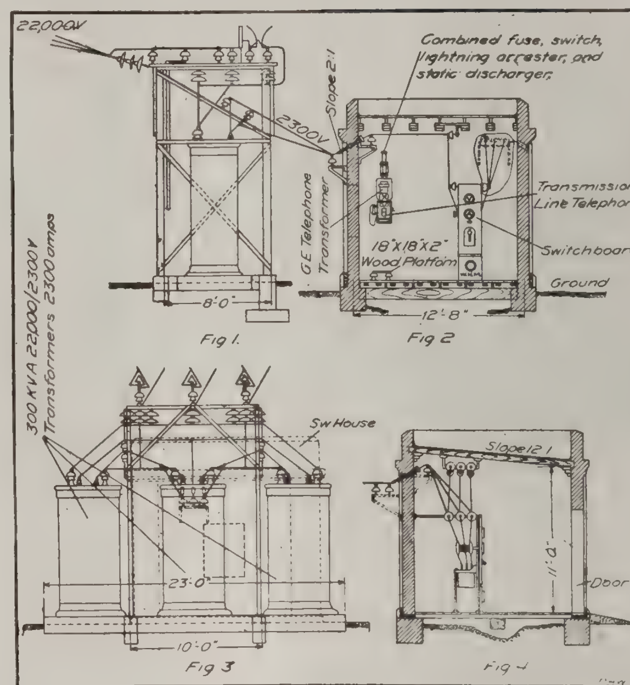


Fig. 9. A Typical Small Substation (900 Kva) at Alexander City, Ala.

Armature and Commutator Troubles—Their Cause, Effect and Repair

BY ALEX R. KNAPP.

COMMUTATOR TROUBLES.

The commutator may be spoken of as the business end of a motor or generator. Most authorities claim that fully 75 per cent of all armature trouble is directly caused by defects in the commutator. In a manufacturing plant using a large amount of motive power, it becomes necessary, as a point of operating economy, to be able to repair and refill its own commutator. Commutator trouble is more easily located than are faults in the armature, but a repair job on one of the old style motors, many of which are still in use, is sometimes a trying and tedious operation. The design of modern commutators has been somewhat improved, and a quick and satisfactory repair can usually be made.

While on the subject of commutators, it will not be out of place to mention a few of the common causes of sparking, which is generally the first symptom of commutator disease. One of the most frequent causes of sparking is due to a rough or pitted commutator. This may be due to a multitude of irregularities, such as overload; brushes out of line; not set at neutral points in regard to load; poor contact; current density per square inch of brush contact too great; short-circuit; open-circuit; weak magnetic field; commutator out of round; high or low bars.

A common cause of sparking which occurs more frequently than any of the above named is due to high mica, which causes the brushes to chatter and make poor contact. This condition causes a rapid blackening and burning of the bars, and as a consequence, the copper is eaten away leaving the mica segments standing out above the surface of the commutator. Some motors seem to be particularly subject to this trouble, which, if there are no defects, is probably due to the fact that the mica is too hard a grade, or else the copper too soft. When this state of affairs exists, the commutator should be turned off. If there is not time for this, the high mica can be removed by grinding down with a piece of sandstone, afterward using fine sandpaper for smoothing.

This high mica, while it may seem trivial at first, is often the cause of more serious complications, and thorough effort should be made to locate the source of the trouble. The commutator may become so hot from the poor brush contact afforded, that the solder is often melted and thrown out, resulting in short-circuit between bars and open-circuits, due to the armature leads becoming disconnected. For these reasons it is given mention here. About the only permanent relief for this condition seems to lie in undercutting the mica. This remedy is recommended when it is reasonably certain that the high mica is caused by the natural condition of the copper or mica. If it is not, then the real cause must be found, for in this case, undercutting would probably improve the running condition somewhat, but would fail to remove the cause.

The mica should not be cut too deeply; a depth of 1-32 inch below the surface of the copper being sufficient. Care must be exercised to remove the mica the full width of the segment, for any thin slivers left flush with the surface will often defeat the purpose for which undercutting is resorted to. This method has corrected some stubborn cases of sparking, and if the job is properly done, all that will be

necessary to preserve sparkless commutation is to keep the slots clean and well below surface of the copper. In a small plant, using a limited number of motors, this operation can be performed by hand with a small three-cornered file. When there is a large number of machines operating, it will be found more economical to purchase a slotting machine for this purpose.

A motor, when it it comes from the manufacturer, may have a commutator that is not "settled." That is, the clamping ring has not been drawn up as tightly as it should. When the machine is put in regular operation and attains its working temperature, the copper expands, and the commutator becomes loose. This is often the cause of high or low bars. To remedy this, the motor should be run until its normal operating temperature is attained, and then shut down. The ring can then be tightened. This process may be required several times, or until the commutator is perfectly solid.

In the case of a high bar, it should be tapped down until it rests firmly against the mica end rings. It can then be filed even with the rest of the bars. A low bar can be raised by prying up, and inserting a narrow strip of mica beneath it, but in the majority of cases this makes a poor job, and usually the only alternative is to turn the commutator down to the level of the low bar.

Probably the most frequent commutator trouble is the burn-out between bars. It occurs often on the corner of the bars, and is not infrequently brought on by oil working along the shaft from the bearing and up onto the commutator. This gradually deteriorates the mica and causes current to leak from one bar to the other, with the result that the mica becomes carbonized, and a short-circuit results. This is one of the causes of burnt-out armature coils. Sometimes the short-circuit will burn itself clear, and no harm will be caused except to burn a hole in the mica. However, it may continue to arc across and burn a good size hole in the bars also.

If a mica segment, or number of segments are burnt, but not too deep, it is often better to clean out the holes well with a thin knife blade and plug them with some kind of filling. If the proper filling is used, and the commutator kept free from oil, it will hold for a year or possibly longer, when they can be renewed. It is always best to save the wearing surface in this manner whenever it can be done, for every time a commutator is turned down in a lathe on an average of three years of its useful life is lost.

The writer has found from experience that a good filling for commutators can be made as follows: Two parts plaster of paris; one part powdered mica; and enough glue to make a thick paste. This, when applied, will dry quickly, and assume about the same degree of hardness as the mica segments.

When a segment becomes burned deep down into the commutator, the only resource is to remove the bad segment and insert a new one. Before attempting to do this, the armature should be thoroughly blown out with compressed air in order to remove all dust that may have accumulated. This is essential, for it is an easy matter for small particles of foreign matter to work in under the back end between the bars and the sleeve when the commutator is loose. Now find out just which mica segments must be taken out, and number the bars at each burn-out, as the bars may have to be removed also in order to get the mica segments out. If the segments were not shellaced when the commutator was built, the chances are they can be lifted right out without disturbing the bars. Otherwise the bars will have to be taken out with the segments.

Remove the bolts that hold the clamping ring in place. Mark the ring so that it may be put back just as it was taken off. Tap the end of the ring lightly with a hammer, and if the mica ring doesn't loosen from the commutator, it will have to be heated, as the ring is probably stuck fast with shellac. Heat the commutator with a torch to an even temperature all around, which will expand the copper and cause it to bulge out from the end ring. Tap the ring again lightly, and it will be found to work loose, when it can be pulled out.

Pry the bars apart slightly at one of the burnt places to see if the mica segments are stuck to the bars. If they are not, it is a simple matter to remove them from the commutator. If they are held fast, the leads from one bar adjoining the burnt segment should be unsoldered and the bar lifted out. The same should be done with the remaining bad places. New segments can be marked off by using one of the bars as a guide. These bars should be scraped and filed clean, and all rough corners caused by boring rounded off.

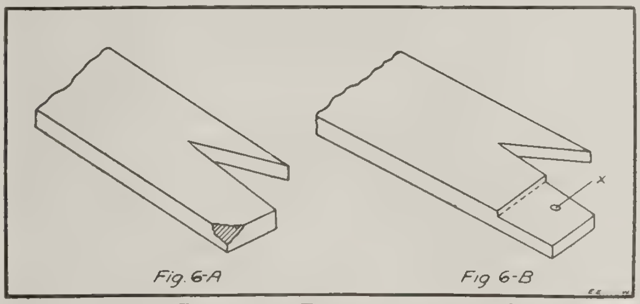


FIG. 6a and b. REPAIR OF BURNT PLACE ON COMMUTATOR BAR.

Frequently it happens that there is a good-sized hole burned in the bar, which will have to be repaired before it can be used again. As there is usually no stock around the average plant out of which to make a new bar, a good repair is the next best that can be done. Fig. 6-A shows the end of a bar with the burnt place where it is usually found. Fig. 6-B shows the method of repair. The bar is cut down enough to remove the burn, and a piece of copper strip carefully squared is soldered in the cut. This should be riveted with a small copper rivet, the location of which is shown at (X). This would prevent the patch from flying out should the commutator for any reason become hot enough to melt the solder. File the patch down to the dimensions of the bar. The cut can be quickly made if a milling machine or shaper is handy, otherwise a good sharp file will answer.

Before replacing the bars, an inspection should be made of the back mica ring, to be sure that no dust or solder has lodged there. The mica segments should be replaced first, and then the bars pushed in. Round the commutator again as nearly as possible into a circular form and replace the end ring. Tighten the clamping nuts as much as possible while the commutator is cold. It is a good idea to paint the end of the commutator with shellac, in order to fill up any cracks that may exist between the bars and the ring.

Warm the commutator to a good heat, and draw up on the nuts again. This baking process must be continued until all shellac is thoroughly dry. The nuts can then be set up again. When the commutator has cooled, it should be

given a final tightening. It is then ready to be trued up. After doing this, the short-circuit test mentioned before will have to be applied, in order to make sure the commutator is clear.

A grounded commutator, in most cases, is easily repaired. More frequently it occurs between the sleeve ring and the end of the bars. A small hole is generally burned through the mica ring or taper cone. Some times the mica ring on the rear end is punctured, in which event a number of bars in the neighborhood of the ground will have to be taken out. The burnt mica should be cut out and a patch put on. When the trouble occurs on the front end of the commutator, remove the ring and cut out the bad mica. The patch should be made as shown in Fig. 7. This new mica must be a trifle thicker than the original mica removed, for it will squeeze together somewhat when the ring is drawn up tight and the commutator heated.

Test for grounds with a test lamp outfit, one terminal being placed on the shaft, and the other passed completely around the commutator. Freedom from grounds will be indicated by the lamp remaining dark.

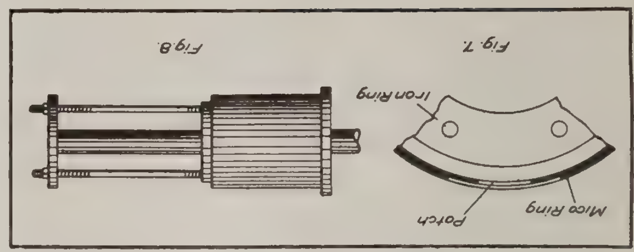


Fig. 7. Patch of Mica Ring of Commutator.
Fig. 8. Device for Removing Commutator.

On some of the old style motors, the sleeve nut is on the back of the commutator. When this happens, the armature leads will have to be disconnected and bent back out of the way in order to work on the commutator. The best thing to do if there be time is to remove the commutator and reverse the sleeve, as both ends are usually bored to the same diameter. Reversing the sleeve in this manner in order to get the nut where it can be easily reached will save much time and work when future repairs are to be made.

The next section of this article will take up refilling of commutators.

Some Suggestions Relating to Conduit Installations

BY CHAS. E. EVERS.

CONDUIT pull boxes are not utilized as frequently as they should be for maximum economy. It is always more economical to install a pull box in a conduit run comprising several conduit lines than it is to bend the pipe. For example, Fig. 1 shows a double bend in a conduit run. At *I* is illustrated the appearance of the bend where a pull box is not used. At *II* the same run is delineated with a special pull box substituted for the bends.

Not only does the pull box decrease the cost of the job, but it renders the pulling in of the conductors easier, and therefore insures minimum damage to the insulated covering of the wires. A pull box should be inserted in all runs at least every 100 feet. Some wiremen make it a practice to space the boxes further apart than this, but such procedure is not the best practice. Runs having a distance of 250 feet between pull boxes have been fished and the conductors pulled into them, but it is quite generally accepted that, everything considered, it is more economical to have the pull boxes not more than 100 feet apart.

Pull boxes for the average situation can be purchased from manufacturers at less cost than that for which they can be made by the contractor. However, as for example, in Fig. 1, special pull boxes are frequently needed, sometimes on short notice. Boxes of this character can, where conditions justify it, be readily made by the wireman out of sheet steel, as indicated in Fig. 2. The box, the details of which are given in Fig. 2, is the one shown mounted on the wall in Fig. 3. The sheet metal, after being cut as shown and punched or drilled for the knockout holes, the rivet and the screw holes, is bent along the dotted line into the form shown. After bending, the corners are riveted together. The cover of the box is held on with round head stove bolts.

Sizes of Clearance Holes for Conduit

Conduit			Size Hole to Drill						
Nominal Size (Inches)	D External Diameter (Inches)		A Approximately ⅛ in. diametral clearance				B Diametral Clearance Ordinarily Used		
	Actual	Fraction to nearest 64th	Actual Size Drill with exactly ⅛ in. clearance	Nearest Even Size Drill (inches) Size H	C Clearance Actual	C Clearance to nearest 64th	H Size Drill	C Clearance Actual	C Clearance To nearest 64th
½	0.840	27/32	.965	31/32	.129	⅛	⅞	.035	1/32
¾	1.050	1 1/16	1.175	1 3/16	.138	⅛	1 ⅛	.075	5/64
1	1.315	1 21/64	1.440	1 7/16	.123	⅛	1 ⅜	.060	1/16
1¼	1.660	1 21/32	1.785	1 13/16	.153	5/32	1 ¾	.090	3/32
1½	1.900	1 29/32	2.025	2 1/32	.132	⅛	2	.100	3/32
2	2.375	2 ⅜	2.500	2 ½	.125	⅛	2 ½	.125	⅛
2½	2.875	2 ⅞	3.000	3	.125	⅛	3	.125	⅛
3	3.500	3 ½	3.625	3 ⅝	.125	⅛	3 ⅝	.125	⅛
3½	4.000	4	4.125	4 ¼	.125	⅛	4 ¼	.125	⅛
4	4.500	4 ½	4.625	4 ⅝	.125	⅛	4 ⅝	.125	⅛

The material used for small sheet steel pull boxes must have walls not thinner than .078 inch which is almost 5/64 inch and is equivalent to No. 14 U. S. Metal gauge. Where the boxes are of cast metal the walls should not be thinner than ⅛ inch. Larger sheet metal pull boxes should be made of metal not less than .109 or 7/64 inch, which is equivalent to No. 12 U. S. metal gauge. All boxes should be thoroughly painted or galvanized after construction. Screw hole should be arranged so that the box can be supported rigidly in position with screws or bolts before the conduit runs are connected into it.

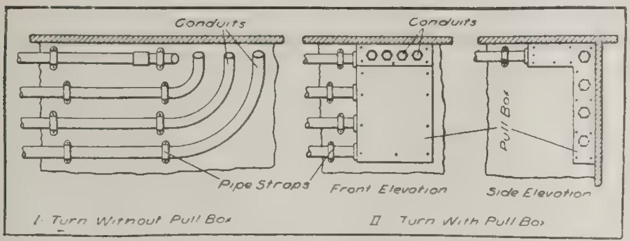


FIG. 1. A PULL BOX SUBSTITUTED FOR DOUBLE TURNS.

Table I shows the diameters of the holes that should be punched or drilled in pull boxes or panel boxes for the accommodation of the different sizes of conduit. There are two divisions of the table. In the right hand division (A) are given the hole diameters where a diametral clearance of approximately ⅛ inch is desired for all of the sizes. In the division (B) of the table at the left are given the diameters of the holes that provide the clearance ordinarily used in practice. In Fig. 3 are indicated the reference letters of the table.

Where wood or any other material that is apt to swell or shrink is to be used, it is well to drill holes of the diameters specified in section A (the right hand section) of the table. If the holes are to be made in metal the clearances given in section B of the table will be ample. A rule that is sometimes used by wiremen in order to determine the size hole that should be bored to accommodate a given size conduit is to add ⅜ inch to the nominal diameter of the conduit in question to obtain the diameter of the clearance hole that should be bored. For example: For ½ inch conduit, a ½ inch plus ⅜ inch, or a ⅞ inch hole should be bored. This rule works out, giving the clearances shown in section B of the table, satisfactory for conduit diameters up to and including 1 inch. For conduit larger than that, the rule will not give a hole of sufficient diameter to accommodate the conduit.

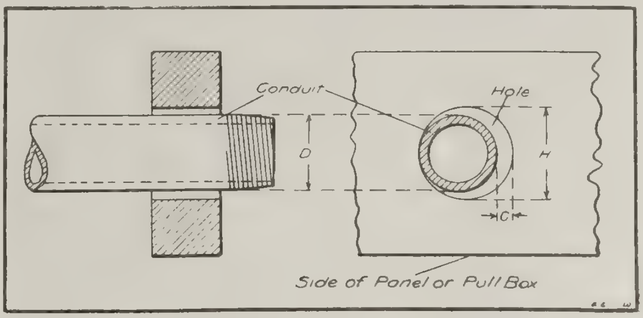


FIG. 3. ILLUSTRATING CLEARANCE FOR CONDUIT.

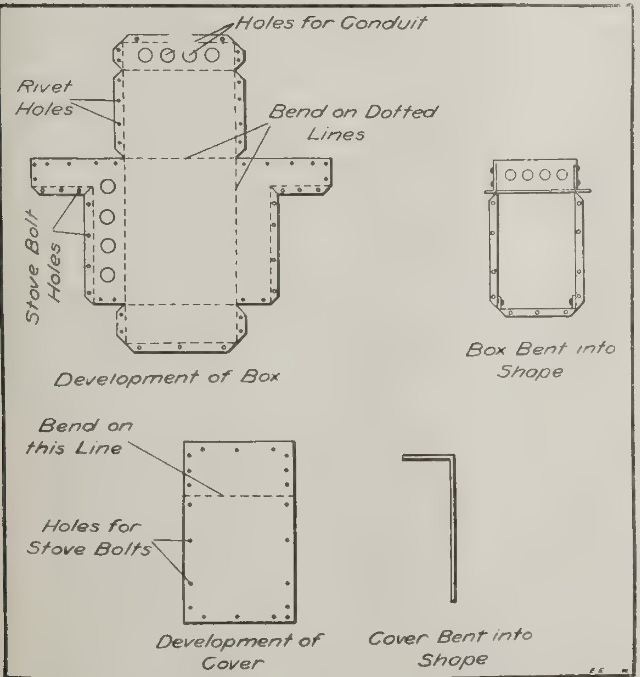


FIG. 2. HOME-MADE SHEET STEEL PULL BOX.

Frequently it is necessary to install the conduit runs before the panel boxes are shipped to a job by their manufacturer. Furthermore, it is frequently the case that the panel boxes in the completed job are to rest in brick or concrete walls. The masons are often in a position to proceed with their work before the arrival of the boxes, which necessitates that the conduit runs into the boxes be installed as the masonry construction proceeds. Unless some provision is made to insure that the conduit, as installed in the masonry, will fit into the holes that are drilled in the boxes when they arrive, there will be considerable cutting and fitting of conduit, and loss of time. This situation can be effectively handled if the wireman will build a dummy panel box of wood for which the metal panel box will later be substituted, and arrange it in the wall or partition at the correct location as shown in Fig. 4, when the masons are doing their work. The locations for the holes for the conduit in the dummy box should agree exactly with those that will be in the metal box when it arrives. The panel box manufacturer can always furnish a template giving the exact locations of these holes before he has even cut the metal for the panel boxes. After the permanent metal boxes are received on the job, the wooden dummy is pried apart and pulled out of the recess, and the metal box substituted for it.

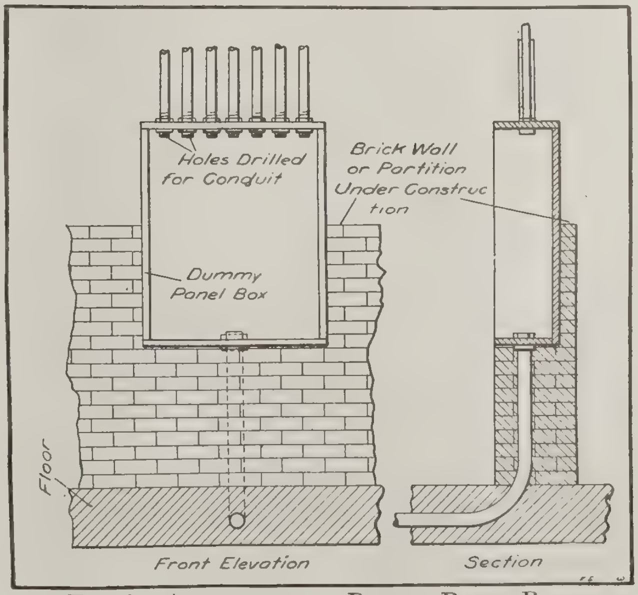


FIG. 4. APPLICATION OF DUMMY PANEL BOX.

In constructing a dummy box such as that described, the top and bottom of the box should rest on the side pieces, so that the side pieces can be pried out readily. Then the top and bottom pieces can be lowered or raised over the conduit ends extending through them, and removed without difficulty. The height of the wooden dummy should be a couple of inches greater than the actual height of the permanent box, so that there will be ample clearance in which

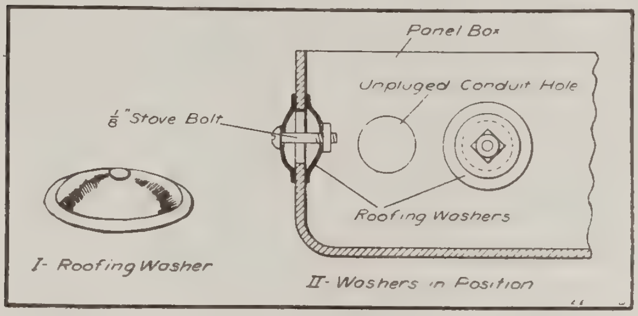


FIG. 5. HANDY CONDUIT HOLE PLUG.

to raise the permanent box up over the ends of the upper conduit, and to drop it down over the ends of the lower conduits. Unless this feature is given consideration there will be trouble in getting the metal box into the recess.

The electrical inspectors will insist that the knockout holes in outlet, panel and pull boxes that are not occupied by conduit, be closed by some satisfactory method. Sometimes wooden plugs are used to close these holes, but no combustible material should be used. A wide-awake inspector will insist on a metal plug of some sort.

Even if the inspector will not see the work, the wireman owes it to himself to plug all the holes, and to use metal plugs for them. The plugging device suggested in Fig. 5 can be easily applied. It consists of a roofing washer such as is used under a nail that secures paper roofing to a surface. These washers can usually be secured either plain or galvanized at any hardware or paint store. Two washers, one inside and the other outside of the box are clamped over a hole with a ⅛ inch stove bolt. After being fixed in position, the exposed portions of the washer and the bolt should be given a coat of black paint to render them inconspicuous. It is usually necessary to ream out the holes in the washers with the end of a file, or with a twist drill, so that they will be large enough to accommodate the bolt. Ordinarily, roofing washers are only of sufficient diameter to cover holes made for ½ inch or ¾ inch conduit. Where larger holes must be plugged, two flat plates of sheet iron, each with a hole in its center can be substituted for the washers.

Pole Line Construction Machinery

BY E. B. HOOK, JR.

THE machinery used for the construction of pole lines for transmitting power is distinct and separate from tools, and of delicate and precise design. It should not be inferred from this statement that the machinery is dainty or fragile. On the contrary, it is massive yet active, strong yet ductile. The design and assembly of this machine is a delicate operation, requiring careful consideration and a thorough understanding of men. The assembling of one simple but complete machine from the human material on hand, making the various crews strong enough to counterbalance one another in their particular positions in the chain of work, is a work that cannot be accomplished by simply designating a number of men to report and be known as a crew. It requires an intimate association with the individuals, a keen insight into their dispositions and tendences, together with an unlimited amount of patience, enthusiasm and interest in the work. The men selected as foremen must be men of some experience and determination, qualified to infuse their crews with the voluntary desire for good fast work.

The hole digging and timber clearing crews must be the pacers for the whole job as they are the foremost part of the machine and their work must be done before the other crews can do theirs. Therefore, it is imperative to have these pacer crews well lubricated and working steadily, and the foreman must be capable of deciding such technical questions as exact locations of poles in unusual conditions, width of timber clearings necessary, etc., and to soothe obstreperous farmers and land owners.

The several crews in the chain following the pacers must be proportioned so as to keep just in working distance of the preceding crew but not to reach it. As in the dog and rabbit chase when almost any mongrel will chase his tongue out as long as his "quarry is in sight, while it takes nerve to run a cold scent; also any American with enough spunk to work is naturally inclined to try and out-do the other fellow, and the logical result is this: The pacer crew decides to run away from its followers and its followers each determine that they shall overtake the preceding crew, then each foreman is notified of the other's intention to catch him, and if the crews have been evenly proportioned and the foreman wisely selected, they each exert their utmost, enthusiasm expands like a whirlwind, and the men become fascinated, with the results of their efforts. The keynote of the situation is "team work," and it is wonderful to witness the speed and perfection with which the great machine progresses. Everybody does more work in less time because they are interested, and at night the men drag themselves into camp dead-tired but happy; the foremen slap each other on the back, claim the advantage in the day's race and plan an early start to try and gain a margin on the morrow.

The most serious objection to this plan is a slight tendency on the part of some of the men to do little things only "good enough." They all know, however, that my one strict rule is—"Nothing but the best will do," and if they manage to slip it over on their crew foreman, they usually get caught when the general foreman comes around. He

makes them do the "good enough" work over again and they lose a little time. The following crew gains a little distance, and they must "cut an extra step" to regain their margin.

The writer has put into practice the above general scheme on a number of jobs in various sections of the country, and secured astonishing results in every case, particularly on transmission line construction. There are, of course, a great many details which enter into the perfection of this human machine, and some of them seem so insignificant as to appear ridiculous at first sight. One example of these details is to have all poles laid off at the holes ready for erection with their tops pointing towards the setting crew. This seems an unnecessary hardship on the delivery crew, but it is as easy in most cases to lay off the poles in any direction, and with a setting crew of fifteen men who would set an average of fifty 50-foot poles per day, when approaching the pole they have to walk from the butt to the top and back again to the butt in setting, which they do not have to do when the top of the pole is towards them as they approach. A few moments' calculating will show that in the former case the fifteen men would walk an entirely unnecessary distance of 5,000 feet in the course of a day's work. This is nearly fifteen (15) miles for one man, a good day's work, so the insignificant detail above mentioned really amounts to the work of one man per day, a useless expenditure of time and energy that costs about $50.00 per month.

Another detail which is anything but insignificant is to feed the men well and plentifully. It is very poor economy to buy cheap food, because at the end of the month it is very little cheaper, and it is absolutely necessary to keep the machine properly fed, strong and satisfied. For this purpose a man is always busy buying fresh vegetables and groceries. He is at all times familiar with the food market, and his one aim in life is to produce good food in sufficient quantities at a minimum price. He is the bosom friend of the cook, and their sole desire is to refill the cavernous fuel boxes of the machine three times a day. The disposition of the cook is another detail worth attention. He can easily ruin the best machine built if he should become so disposed. Light delivery teams are used to send out dinners on the job. This serves the two-fold purpose of delivering the food hot and conserving the energy and time required for the men to come into camp for it.

Camp regulations are few but strict. Sanitation is by far the most important item, and camp locations are selected with this fact in mind. My one inflexible rule is—"no drinking and no gambling," and I take precautions to see that it is enforced to the letter. This rule covers a multitude of smaller sins which would be a serious menace to the efficiency of the machine, to say nothing of the tranquility of the country at large. Another important item, for obvious reasons, is the securing of good teams and proper wagons for the distribution of heavy material.

By keeping a close personal watch on the individual man, his methods and physical movements in performing his work can often be improved. A slight reprimand when necessary, a word of approval when due, just a touch here and there goes a long way towards reducing lost motion and increasing the efficiency of the machine. He was a far-seeing man who said, "It is the little things in life that count."

Regarding this outfit as a machine, great care must be exercised not to forget the human and personal side of the mere man. Laborers are a class quick to take offense at a careless word, and imagine personal grievances. They must be made to realize their worth and responsibility, and to understand that each individual man has his own part to play in the great game of "Pull Together," and that the best he has in him is expected of him all the time he is on the job. He must also understand that at any time he gets the impression that his services are indispensable, right then he is not only worthless but his immediate extraction from the machine becomes absolutely necessary. He may believe himself to be the ignorant laborer who works for small compensation, but the expense of the by-products of his ignorance, inefficiency and violence to the machine more than offsets any advantage that his cheapness may be. This class of corruption is contaminating, and likely to divert the efforts of a well-trained machine into dangerous channels.

With a view to reducing the hazard of such occurrences, the writer holds a meeting in the construction office once a week. All foremen and sub-foremen attend these meetings and discuss ways and means of simplifynig and improving portions of the machine. All suggestions are thoroughly considered from every angle, especially from the "safety first" view, and approved or disapproved to their merits. This serves the double purpose of making the men forget their imaginary grievances and think about their work. They gradually realize that their own ideas are worth consideration and rely more upon themselves and express their opinions. A large variety of valuable suggestions and schemes have been derived from these discussions, and the influence of good will and good thinking is beneficial to all.

Present Tendency in Establishing Branches in South America.

Several leading European and American manufacturers of electrical materials are represented at Buenos Aires either by agents or by branches. The present tendency appears to be to establish branches. As regards Rosaria, one of the large German factories has a branch here, and an electrical concern with factories in several countries is represented by the Rosario branch of its Buenos agents. Other concerns represented at Buenos Aires are in close touch with the Rosario market, most of them selling to local dealers without distinction. Some of the large general importers of hardware and machinery at Rosario maintain an electrical section, import electrical pusplies, and install lighting systems, small power plants, etc. There does not seem to be much inclination on the part of these large hardware and machinery jobbers to extend this branch of their business; in fact, it appears from information obtained recently that some of these firms intend to give up their electrical sections, as the active competition of a host of small electricians, largely Italians, has reduced profits on electrical work to a minimum. The tendency is, rather, for the leading manufacturers to establish branches at Buenos Aires, which will presumably be followed later on by suboffices at Rosario, which deal direct with the electricans and retailers.

Modern Show Case Lighting

BY WILLIAM S. KILMER.

It seems to be the prevailing practice of many merchants to flood the exterior show windows with light, and put little thought, if any, to a proper system of show case lighting. It is quite true, that prior to the last few years, the methods available for this purpose were very meager and unsatisfactory. The show case problem is a large one involving a considerable part of the equipment. The average metropolitan department store has 3,000 feet of aisle and wall cases, while the frontage for show windows will not average more than 300 feet, or 10 per cent of the show case equipment.

The merchant dresses and lights his windows to attract the interested and disinterested public. As an advertising medium, it ranks even with the newspaper and car. When reputation, show windows and advertising have done their work, the store should be full of the buying public. The more merchandise that can be shown in a short space of time—the greater the sales. A customer may come to a store for a paper of pins. A well-lighted leather or lingerie goods case attracts and the sale increases by $5.00 or $25,00. Another feature is that well-lighted goods sell more rapidly without handling, as a closer selection is made possible without removing them from the case, as it stands to reason that if a piece of merchandise is shown in its true color and perspective, it will look the same when removed from the case. Thousands of dollars are lost by the continual handling of delicate and perishable goods unnecessarily, and many a first installation cost of a show case lighting system is saved by this single feature. While on the other hand, a poorly lighted case is often worse than one without any form of artificial lighting, because the light rays are often of such a color as to completely change the color of the goods, and a poor distribution of light may entirely alter the form.

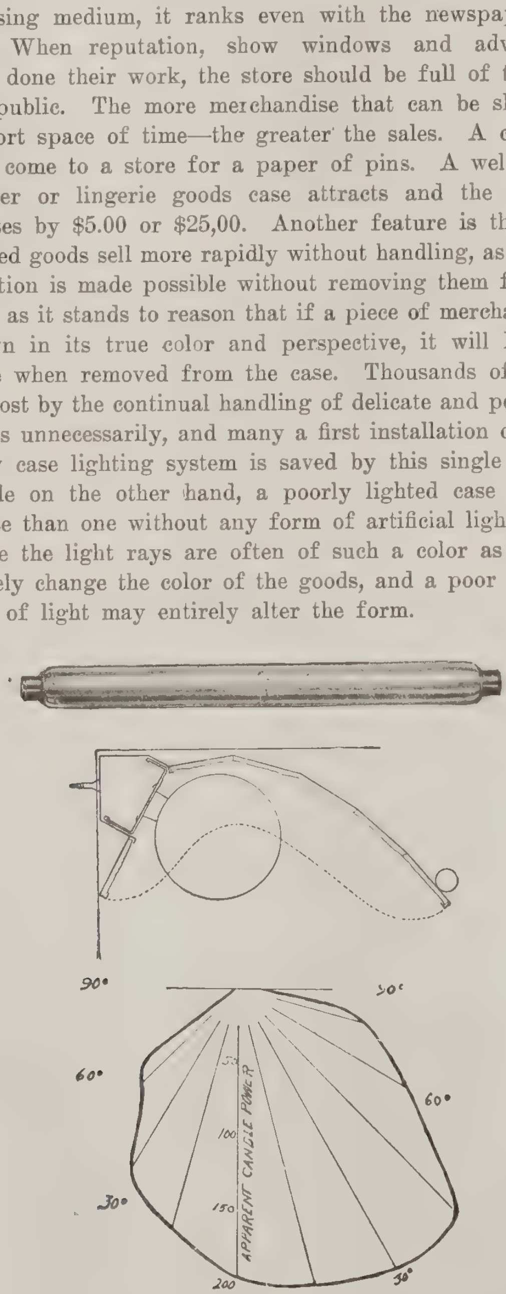


Fig. 1. The Linolite Lamp, Show Case Reflector and Distribution of Light.

In selecting any form of a show case lighting system, the following vital points should be placed before the progressive merchant: (1) The system must give an illumination in the interior of the case, which is approximately double that of the general illumination of the store interior. (2) The light must be of such a quantity and quality that the goods are shown in their true color and style. (3) The interior temperature of the case must not be raised to any appreciable extent, and any increase, however small, must be evenly distributed, as a glass case which is warm in spots is very liable to crack with the first cold draft which strikes the exterior. (4) The unit of light must be neat and inconspicuous, and permit an easy and thorough cleaning of the case. (5) General efficiency.

A lamp which meets this condition in a remarkable degree of accuracy is the long tubular or Linolite lamp, shown in Fig. 1. This lamp is approximately one foot long and one inch in diameter. The tungsten metal filament runs parallel to the tube through the entire length of the lamp, the electric current passing through from end to end. The interior glass area of this lamp is 31 square inches against 17 square inches of the ordinary "Bung Hole" type, and 24 square inches of the ordinary bulb lamp of the same wattage. This large glass area insures low temperature and long life, and on account of its peculiar shape, it adapts itself to a very small reflector. Fig. 1 also shows a reflector 2½ inches deep and 2 inches high. It is scientifically designed, and throws a powerful and correct distribution of light, as is shown in the candle power diagram.

The views shown here are all time exposures, and show the practical application of over 3,000 feet of this system in the new palatial store of Lipman, Wolf & Company, Portland, Oregon. The perfume cases are 18 inches deep and 3 feet high with a glass door for the front and rear. All cases are finished in Circassian walnut. Four 25-watt Linolite lamps are used to each one, with the corner aisle cases, 30 inches deep and 38 inches high. The even illumination over small irregular merchandise is very noticeable. Four 25-watt Linolite lamps are used for every 8 feet of frontage. This method is also followed for the display cases and shelving shown in the rear of the aisle case.

The aisle and wall cases in jewelry department displaying glass and silverware are shown in Fig. 2. The reflectors of these cases are finished statuary bronze. The wall cases are three feet deep and five feet high with two plate glass shelves. All cases have mirror backs, exterior finish Circassian walnut. It will be noted that there is no back reflection from the mirrors. This photograph also shows an interior view o fthe show window lighting system. This reflector is a Frink trough reflector shown in Fig. 4. It is finished in white corresponding with the rest of the window. All reflection of light as well as the source of light is out of the field of vision from both the interior and exterior of the store. Aisle and wall cases of the corset department are shown in Fig. 3. The aisle cases are 30 inches deep

FIG. 4. FRINK TROUGH REFLECTOR FOR WINDOW LIGHTING.

and 32 inches high, finished in mahogany with four Linolite lamps per 8 feet frontage. The wall cases are 2 feet deep and 3 feet wide with 3 Linolite lamps to each case. The equipment was furnished by the H. W. Johns-Manville Company.

Platinum in Telephone Apparatus.

It is an interesting fact, perhaps not generally known by operating telephone men, that precious metals such as platinum, gold and silver, and even precious stones such as diamonds, are used extensively in the manufacture of telephone apparatus. The Western Electric Company, the largest manufacturer of telephones in the world, uses upwards of one ton of platinum each year for the contact points of telephone apparatus. When it is considered that the value of platinum is 30 per cent greater than that of pure gold, it will readily be seen that this expensive precious metal would not be used extensively unless results justify it.

Experiences With Line Transformers

BY D. W. ROPER.

WITHIN recent years the line transformer has been developed by manufacturers into one of the most efficient and reliable pieces of electrical apparatus. That the transformer is a reliable piece of apparatus is made plain by Mr. Roper in a paper presented before the American Institute of Electrical Engineers which gives an analysis of transformer operation for one year on a system having 15,000 transformers installed. In what follows an abstract of this paper is presented. He says that the total cost of maintenance and repairs of all transformers on the distributing system discussed was about 2 per cent of the value of all transformers at present prices. This figure indicates that any suggestions for improvements would be in the nature of refinements of design or construction, and further, that if such refinements involve material increase in the price they would be justified only for those companies which place a high value on continuous service to their customers. It appears possible, however, by some slight changes in the details of construction of the transformer and some improvements in operating methods, and without any material additional expense, to eliminate about 50 per cent of the troubles directly traceable to the transformer. A record of the transformer troubles on the system for the year 1913 is given in Tables I and II.

TABLE I. RECORD OF TRANSFORMER TROUBLES FOR THE YEAR 1913.

Total capacity, 129,056 kw.

Approximate total value at present prices, $1,000,000.

Size of transformers	Cause of Troubles: Lightning	Overloads	Defective	Grounds and short circuits on secondary wiring	Miscellaneous and unknown	Totals	Total transformers in service Dec. 31, 1913
	Number of Cases of Trouble						
1	4	..	2	..	2	8	444
1.5	26	2	4	2	12	46	1,108
2	16	2	1	3	6	28	1,100
2.5 and 3	21	3	3	2	3	32	2,235
4	13	2	4	..	2	21	1,056
5	9	..	4	1	6	20	1,951
7.5	23	..	2	..	11	36	2,071
10	9	..	2	1	1	13	1,626
15	2	1	..	..	..	3	1,113
20	1	..	..	..	..	1	515
25	1	..	..	..	..	1	350
30	1	..	..	..	..	1	207
37.5 and 40	..	1	..	..	1	2	139
50	2	1	1	..	1	5	241
75	..	..	..	..	..	0	43
100	1	..	..	..	2	3	54
150	..	..	..	..	..	0	3
200	..	..	..	..	..	0	16
250	..	..	..	..	..	0	2
Totals,	129	12	23	9	47	220	14,274

In discussing possible improvements in the specifications of transformers, it is convenient to use as a basis the standard specifications of transformers issued by the Bureau of Standards as Circular No. 22 in 1911. The introductory paragraph in these specifications reads as follows: "These specifications have been drawn up with the purpose of providing a standard specification for the purchase of transformers of the type most commonly used both by the government departments and other purchasers. They have been so drawn as to secure the most serviceable apparatus on the market, and at the same time to admit the regular product of reputable manufacturers. To this end the co-operation of government engineers and of representatives of many of the leading manufacturers has been secured, and it is largely due to help and criticism from these sources that the specifications are representative of the best practise among manufacturers."

	Due to Lightning	Other Causes	Total
Fuses blown	911	678	1,589
Transformers burned out	129	91	220
Total cases of trouble	1,040	769	1,809
Cut-outs destroyed	77	332	409
Ratio of cut-outs destroyed to total cases of trouble	7.4	43	22.5

TABLE II. RECORD OF THE FUSES BLOWN AND CUT-OUTS DESTROYED DURING THE YEAR 1913.

It is assumed that these specifications fairly represent the present American practise. The criticism of the specifications which follow are, therefore, to be considered against the present practise rather than against the specifications.

The experiences of the author on which this paper is based have been gathered during his connection with the system of the Commonwealth Edison Company in Chicago, and it will be understood, unless otherwise specified, that the experiences and records herein mentioned refer to the system of this company. As this distribution system covers about 125 square miles of territory, including sparsely settled suburban districts, as well as thickly settled urban territory, it is thought that the installation may be regarded as fairly typical.

NAME PLATE.

The standard specifications require a name plate, but make no mention as to its location. It is the custom of the manufacturers to furnish a name plate on which the lettering is of sufficient size to be read when the transformer is standing on the storeroom floor, but which is somewhat more difficult to read when the transformer is installed on the pole. Securing the correct number of a transformer is made particular difficult in the larger sizes of transformers because the name plate is located on the front of the case near the top. This puts the name plate so far from the pole that the lineman must unsnap his life belt in order to get in a position where he can read the name plate. If the *safety first* campaign is to be extended to name plates on transformers, they will be located in such a position and the lettering will be of such a size that a for handling transformers. The transformers, however, must be handled many times while in the storeroom or in lineman, without risking his life, can read the name plate while the transformer is in position on a pole.

SPECIFICATION ON CASES.

The standard specifications provide for eyebolts or hooks transit from the storeroom to the line. Last year, in Chicago, the number of transformers replaced in order to increase the capacity was equal to the number installed, and the total number handled during the year was over 40 per cent of the number on the lines at the end of the year. Transformers of 5 kw. and smaller capacity comprise over 60 per cent of the total number installed. With the class of help that is used in this work it is very difficult to prevent the men from using the primary or secondary leads as handles. It appears possible for the manufacturers, at no great expense, to fashion the covers of the smaller sizes of transformers so as to provide a handle on each side that would be somewhat more convenient for the purpose than the primary leads.

No mention is made of terminals on the primary or secondary leads, but such terminals appear to be quite desirable and are furnished by some manufacturers. It has been suggested that terminals should be located just outside of the porcelain bushings with a solid rod through the bushing. If this could be done, the leads would be so short that there would be no temptation to use them as a handle and, in addition, the solid rod sealed into the bushings would absolutely prevent the siphoning of the oil through the leads. In this manner two of the most aggravating petty annoyances in connection with transformers would be eliminated.

SPECIFICATIONS ON CUT-OUTS.

The specifications require two primary cut-outs to be furnished with each transformer, but make no mention as to the qualities desired by these cut-outs, assuming apparently that any cut-outs supplied by the manufacturer will be satisfactory. This assumption is not warranted by experience. The number of cut-outs replaced in a year exceeds the total number of burned-out transformers, indicating that the cut-outs are a less reliable piece of apparatus than the transformers. On the system under discussion the larger sizes of transformers were operated without cut-outs for several years, as it was found that better service could be given to customers in this manner than with the types of cut-outs which were available.

If a company is buying transformers on specifications, the probabilities are that within a few years there will be transformers on hand made by several manufacturers and as several makers furnish their own type of primary cut-outs and must keep in stock and furnish to their trouble men a full line of the various sizes of primary fuses for each of the several makes of transformers. It would be a better plan to have the transformer furnished without cut-outs and for the operating company to secure the cut-outs that are found to be best adapted to its purpose, using one type for the smaller sizes, with one or two additional types of cut-outs for the larger sizes of transformers. Enclosed fuses appear to be the only satisfactory type for the sizes above 40 kw.

Some of the points that should be included in the specifications for transformer cut-outs are as follows:

(1) They should be capable of opening the circuit of the transformer whether the short circuit occurs when the cut-out is cold or when it is heated, due to the load.

(2) It should be impossible for the plug to drop out due to the jarring of the pole, or to be blown out by blowing of the fuse or by short circuits or arcing in the cut-out.

(3) It should have sufficient distance between terminals so that if the fuse blows in a driving rain or wet snow storm, the current will not leak across the cut-out between terminals and destroy the cut-out.

(4) The plug should be provided with a handle of such size and shape that the cut-out can be readily removed by a troubleman when wearing rubber gloves and when the handle is wet with rain or covered with sleet.

(5) The plug should have a shield of such size and shape that when the plug is inserted on a short-circuited transformer the resulting arc will not cause any injury to the troubleman.

(6) The cut-outs for the smaller sizes of transformers should be designed for the use of metal strip fuses. The fuse-holding parts should be designed so that the fuse can be readily replaced.

Some further attention should also be given to the subject of the metal strip fuses for primary cut-outs. In some parts of the city these fuses corrode badly, reducing the cross section of the strip so that the fuses will blow on light loads, and without any apparent trouble in the transformer or on the customer's premises. Some experiments are being made with coated fuses which it is hoped may eliminate the trouble.

This article will be continued, giving other data.

Installation, Operation and Maintenance

This section is devoted to practical suggestions, experience and data, and is open to all readers who have something to say on every day work and trouble in the plant or sub-station, on the line, in the factory, mill or elsewhere.

Motor-Generator Balancing Set in a 3-Wire System, as Supplied from a 2-Wire Generator.

It is necessary to make use of a balancing set, when a three wire circuit must be supplied from a two wire generator. Otherwise, if the load on the two sides of the three wire circuit becomes unbalanced, the lamps on the lightly loaded side will receive more than their rated current, and hence may be burned out. The motors on such a system are usually connected across the outside wires, and hence are not affected by an unbalanced condition. The accompanying diagram, to which the following explanation applies, illustrates the connections of a balancing set on a three wire circuit.

When the currents taken from both outer wires are equal, there will be no return current in the middle wire. In such a case the balancing machines will both run as motors, taking current in series from the mains. As they run without load, however, they are run at a sufficiently high speed to make the current flowing through their armatures very small, owing to the counter emf. set up due to the high speed. In such a case, they will only absorb the amount of power necessary to overcome the frictional and other losses in them. With the ideal condition, the difference of potential between each outer wire and the neutral, is exactly half the difference of potential between the two outer wires. Now, the machines will only act as balancers when one takes current, and acts as a motor to drive the other as a generator, and this can only happen when the voltage between one pair of wires is greater than the voltage between the other pair. If the two voltages were equal there would be nothing to make either machine act as a generator rather than the other. An example will illustrate this point, as to what difference may be expected between the voltages of the two sides.

Suppose that with no current in the middle wire and a voltage of 110 between the outer wires and the middle wire, it is found that the current taken by the balancing machine is one ampere. Then, the power taken by both of the machines to overcome the losses in them when running light is $2 \times 1 \times 110 = 220$ watts. If the loading on the system is altered so that the positive main is more heavily loaded than the negative main, and an out-of-balance current flows in the neutral wire amounting to two amperes, the current will divide at the balancers and one ampere flow towards the positive main through one machine and the other towards the negative main through the other machine. There will then be two equal and opposite currents in the machine connected to the positive wire and these will neutralize each other, which means that this machine will run without giving or receiving current. At the same time there will be two amperes flowing through the armature of the machine on the negative side in a direction such as to drive it as a motor. The power expended in driving the two machines remains the same as before, but it is all exerted in the armature of one machine. There will be a loss of voltage in the armature of the motor equal to the product of the current and the armature resistance. Hence, there must be this amount of voltage at the motor terminals in excess of the pressure or voltage at the terminals of the other machine. This excess voltage will be the least difference in pressure between the two sides of the system which will enable the balancers to operate. As the out-of-balance current increases, an increased current will flow through the armature of both machines, and the losses in each will increase. This will require a larger current in the motor machine to enable it to drive them. This in turn involves greater loss of voltage in the armature of the motor machine and hence greater difference in voltage of the sides of the three wire system.

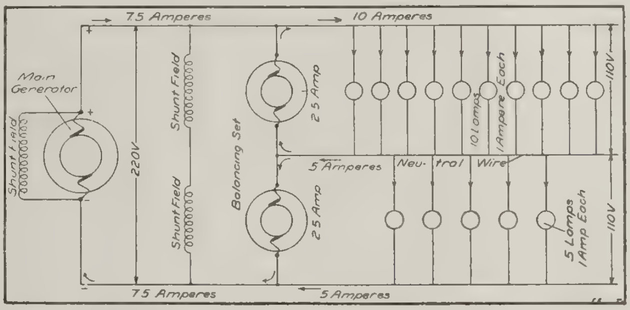


FIG. 1. CIRCUITS OF TWO-WIRE GENERATOR AND BALANCING SET SHOWING ACTION FOR UNBALANCED LOAD.

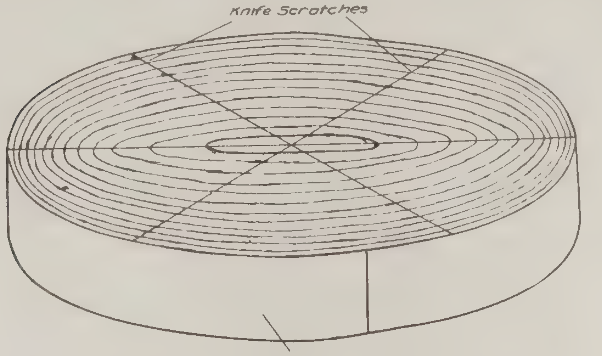
In the diagram there is an unbalanced current of five amperes, flowing in the middle wire at the end nearest to the generator. If this return current were not allowed to flow in the neutral wire, there would necessarily be the same current flowing from the neutral to the negative wire as flows from the positive wire to the neutral. Now, as indicated in the diagram, since there are ten parallel and equal resistances connecting the positive and the neutral wires, and only five parallel and equal resistances between the negative and neutral wires, therefore, the total resistance on the positive side of the neutral wire is one-half of the resistance on the negative side. Hence, the voltage between the negative and neutral wires, would be twice the voltage between the positive and neutral wires. In general, the difference in pressure between the more heavily loaded outer wire and the neutral wire tends to be less than one-half the voltage between the outer wires. At the same time the voltage between the middle wire and the more lightly loaded outer wire tends to rise by the same amount. It is this difference of pressure which enables the balancing machines to operate and it is this variation in pressure that they are intended to overcome.

As indicated in the diagram, half the return current in the neutral wire will flow through the armature of the machine connected to the lightly loaded wire, and in so doing will drive the machine as a motor. This machine will drive the other machine which is coupled to it and cause it to act as a generator, and also cause it to supply an equal amount of current to the more heavily loaded wire to which it is connected.

At the very instant of starting up such a system the main generator D must supply all the current that is circulating in the system, but just as soon as current tends to flow in the two sides of the system so as to produce differences in voltage, as stated, the balancers will begin to act and help supply the extra current required on the more heavily loaded side. T. De Laney.

To Prevent Raveling of Friction Tape.

When using friction tape the electrician is more or less bothered by the outside edges raveling when the tape is unrolled. This can be avoided by scoring both sides of the roll with three scratches made by a sharp knife. This



SCHEME TO PREVENT TAPE FROM RAVELING WHEN UNROLLED.

breaks the continuity of the outside threads and permits the taking off of any length of tape without raveling. The diagram shows the scheme.

Rolling Versus Cutting Threads of Cross-Arm Pins.

In the February National Electric Light Association's Question Box a point was raised which is of interest to all construction men. It follows:

1.3221-42. What are the relative advantagesand disadvantages of the following types of combination pins for 11,000 or 13,200-volt service:
(1) Steel through bolt, wooden thimble and porcelain base.
(2) Steel through bolt, lead thimble and porcelain base.
(3) Malleable iron pin with separable lead thimble.
(4) All malleable iron pin with felt in thimble slot.

Of several answers published, that of Mr. C. E. Scribner, of the Western Electric Company, gives a clear and concise explanation of the method of rolling threads on through bolts and carriage bolts, and on account of his position as chief engineer of the largest buyer of pole line hardware in the country, shows the attitude of large users on this subject. Mr. Scribner's answer follows:

"The cutting and rolling methods of forming threads differ markedly. By the former method a revolving die is made to form a thread by cutting away or removing some of the material and the outside diameter of the thread remains the same as the diameter of the stock. To roll threads there are two massive plates, separated from each other by a space a little greater than the root diameter of the threaded section. The dies for forming the threads are placed on the inner surface of these two plates. A reciprocating motion is imparted to one plate and as the blank bolts are fed between the surfaces, one at a time, the thread is pressed or formed.

"The rolling process does not remove any material. The material is forced away to form the root of the thread, and must find an outlet. The formation and action of the dies causes this excess material to build up and form the apex of the threads. For this reason the outside diameter of rolled material is always slightly greater than the diameter of the stock. The stock for crossarm bolts is 9-16 in full, and when threaded by the rolling process the outside diameter of the thread becomes 10-16 inch.

"The wording of the question suggests that a lack of strength in the dies is the factor which prevents the rolled thread from having the same outside diameter as the stock. The strength of the die has no bearing on the case from this aspect. You will note that by the nature of the process, the outside diameter of the threaded section must be greater than that of the stock.

"My comments apply, of course, to the commercial methods of manufacture which are now prevalent. I understand that several means have been devised for rolling threads of the same outside diameter as the stock. None of these, so far as I know, are being employed commercially and I am unacquainted with the details of the operation."

T. C.

Efficiency.

At this time a great deal is being said and written about efficiency and quite properly, inasmuch as efficiency has come to be the one thing which is characteristic of all successful modern business. The word "efficiency" is being applied to a great variety of activities and operations of both men and machines, and it would be remarkable if some of us did not become confused as to the real meaning of the word.

In a mechanical sense, efficiency is a measure of the work done by a machine compared with the amount of power applied to the machine in causing it to do the work. For instance, if a horse-power of energy is applied in driving an engine, and the engine turns out only eight-tenths of a horse-power of work, we say the engine is but 80 per cent efficient. In other words, 20 per cent of the energy has been wasted in the process.

The real attainment of high efficiency resolves itself into the reduction of waste to a minimum. This is true whether the idea is applied to machinery, or to the actions of persons, or to the results obtained by a group of men engaged in business.

Waste might be defined as energy improperly applied, and such definition will hold true wherever energy is applied or exerted for a definite purpose. There is an efficient way to do nearly everything, and there is a wasteful way. There are efficient ways of plowing a field, or sharpening a pencil, or managing a home, or a business, or a government, and there are wasteful ways. Where all waste has been eliminated it will be found that each person or machine is working to best advantage.

It is interesting to think of what the idea of efficiency implies when referred to the activities of a person going about his daily work. We are told that a person is working at a high efficiency when he applies all of the energy at his command to his work. If this is true it means that wasted (energy improperly applied) must be kept down to a minimum; it means that a person will concentrate his entire attention upon his work, thinking out, if possible, new ways by which the work can be done more quickly and accurately; it means that there will be a minimum of time wasted in thinking of things which do not pertain to the work at hand.

In a boiler plant we speak of "capacity" as the amount of steam a boiler makes in a certain length of time; "efficiency" is the relation of the heat in that steam to the heat in the coal burned in making the steam. If we use this idea in applying the personal efficiency test, we find one person to be a "good steamer" and an efficient one as well, while another by giving to his work the maximum amount of the energy which is in him, must be content to feel that he is working at a high rate of efficiency.

E. H. Tenny, *Engineer with Union Electric Light and Power Company, St. Louis, Mo., in Company's Bulletin.*

Converting Arc Lamps Into Nitrogen Lamp Containers.

The introduction of the recently developed gas filled lamp and its increasing popularity for street and commercial lighting has made necessary a new design of container for its successful and efficient operation. There were two ways of meeting these requirements; namely, by redesigning and converting the existing arc lamps into suitable containers, or the purchase of entirely new equipment. Of the many advantages offered by the first mentioned method, the most important is that of economy, for after many tests and considerable experimenting, it has been found possible to convert the arc lamp to gas filled lamp container at considerably less than that which would be charged for new equipment.

From an operating standpoint there were two factors to contend with, first the absolute elimination of rain water in contact with the lamp bulb and second so housing or enclosing the lamp that the leading-in wires in the lamp would be operated at the lowest possible temperature. The first may be accomplished by the introduction of baffle plates in the arc lamp housing so designed as to eliminate the entrance of water and still provide sufficient clearance to permit air stream to flow with the least possible resistance. When this type of lamp is burning tip down, the lamp base and all that section of the lamp within the cylindrical formation are subjected to comparatively high temperature and it is found essential to so design a unit as to operate this particular section at the lowest possible temperature.

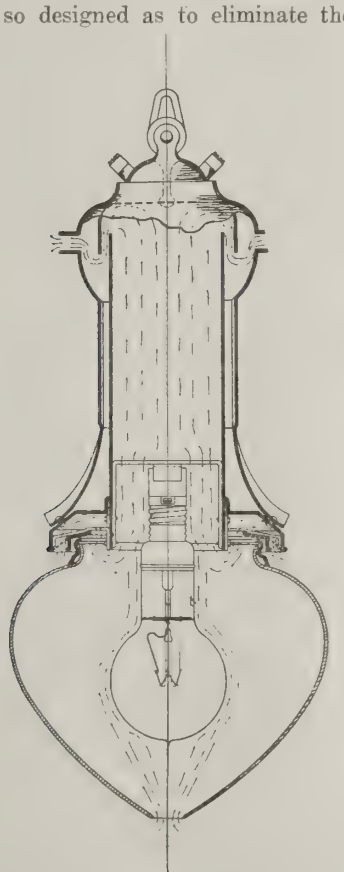


Fig. 1. Arc Lamp Adapted to Use Gas Filled Tungsten Lamp.

The unit shown in cross-section in Fig. 1, has been designed with these points in view and it will be noted that the entire design takes the form of a chimney with cold air entering beneath the lamp at the bottom of the globe which rises rapidly and becomes heated after enveloping the lamp bulb, passes upward with considerable velocity and in so doing induces a volume of cold air to enter above the top of the globe as illustrated. This particular cold air stream entering above the globe top and being directed against those lamp parts liable to high temperature causes them to actually operate at a temperature lower than would obtain if the lamp burned in free atmosphere. This design has been developed by the Metropolitan Engineering Company of New York City.

Lubricating Oil Tests.

Lubricating oils are frequently subject to quite a number of tests. Some of these are very simple to perform, others again are not easily carried out, and for this reason are often omitted. Lubricating oils may be subject to the following tests: 1. Impurities: determination of possibility of adulteration; 2. Tendency to gum; 3. Presence of acids; 4. Viscosity; 5. Density; 6. Flash point; 7. Burning point; 8. Chill point; 9. Evaporation; 10. Volatility; 11. Durability; 12. Coefficient of friction; 13. Thermal conductivity.

Purity—Mineral Oil.—Impurities in mineral oil are generally of animal or vegetable origin. To determine the presence of animal and vegetable oils in mineral oil, mix with the sample under test an alcoholic solution of sodium hydroxide or potassium hydroxide, and gently heat to 100° C, when the metal of the hydroxide saponifies the fatty acids of the adulterant, the soap separating out. Sulphur compounds are often present in oils that have been poorly refined. Their presence can be detected by heating the sample to about 150° C for twenty minutes or so, when the color of the oil will darken considerably if sulphur is present.

Animal and Vegetable Oil.—Mineral oils are as a rule cheaper than animal and vegetable oils, and as a result mineral oil is often used as an adulterant. In cases where the admixture of mineral oil is high its presence may be detected by its bloom or sheen. Bloom may readily be detected by dropping a small quantity of the oil on a "black plate" when, if looked at from an angle, the iridescent coloring shows up if unbloomed oil is present. This method—known as the optical method is liable to considerable error because mineral oils may be debloomed by the addition of nitro-compounds such as nitro-naphthalene or bi-nitro-benzol, for which reason the saponification method is advisable. To determine the adulterant of vegetable oil and animal oils amongst themselves, quantitive determinations as well as the saponification method are necessary. For this determination it is necessary to determine the quantity of hydroxide required to completely saponify the oil, and compare it with that theoretically called for by the oil under test. The presence of mineral soaps is determined

by burning the sample of oil, the purity being judged by the quantity of ash in the residue.

A very approximate indication of adulteration may be obtained by reason of the fact that at any given temperature each animal and vegetable oil has a definite specific gravity. This indication is not a very safe guide, however, because many oils have almost the same specific gravities.

It is often desired to be able to distinguish between animal and vegetable oil, and this may very easily be done by passing chlorine gas through a sample of the oil; vegetable oil will burn white and animal oil burns brown.

Gumming.—When oil is exposed to the air it tends to gum and dry-up, the oil tending to become a resin by process of oxidation. This test generally consists of letting the oils under test trickle down a smooth metal plate at an incline of about 2 per cent, and noting the relative distances travelled in a definite time. An oil testing machine is sometimes used for this test. Irrespective of the method used it is necessary to use a standard oil for reference purpose.

Acidity.—A test for acidity that indicates acidity but not the proportion of acidity may be obtained by blue litmus paper. A very sensitive test, proposed by the late Dr. Chas. B. Dudley, of the Pennsylvania Railroad, is as follows: Measure out 8.9 grames of oil for test. Dissolve a few grams of carbonate of soda in a solution of 95 per cent alcohol, and allow to settle. This solution call solution No. 1. Make up a caustic-potash solution of such strength that 31.5 cubic centimeters neutralizes exactly a 5 c.c solution of sulphuric acid and water containing 40 milligrams (H_2SO_4) c.c Call this solution No. 2. To the sample of oil under test add about 2 ounces of No. 1 solution then add a few drops of tumeric solution, and shake thoroughly, when the color becomes yellow. Now add solution No. 2 until the color changes from yellow to red. (The most satisfactory piece of apparatus to use for this purpose is a burette graduated in c.c., when the acid will be in proportion to the amount of solution No. 2 required to turn the oil from yellow to red.

Density.—The specific gravity as density is almost always found by the oleometer, which is a specific form of hydrometer. It is important to have the oil at proper temperature at the time of test; a temperature of 60° F (15.6° C) is usually considered standard. Another way to find the density is, of course, to weigh a given volume in oil and then in distilled water, or a given volume on a balance. For accurate work, and for uniform results, it is always advisable to agitate the oil most thoroughly immediately before test.

Viscosity.—The viscosity and density of oil are closely related, as are likewise viscosity to the lubricating properties. The viscosity of oil is generally considered to be inversely proportional to the rate of flow of oil through a standard nozzle, while constant or a constantly diminishing head is maintained at constant temperature. A comparison must be made with water or some standard oil which has well-known characteristics, such as sperm oil. The apparatus for this test is known as a viscosmeter, of which there are quite a number on the market of one kind and another.

The test for viscosity is quite an important one since it enables one to determine the lubricating properties of oils. As the viscosity differs at different temperatures it is important that one definite temperature be standardized a temperature should be chosen that will be somewhat higher than that which may be expected in practice. It is well to test the viscosity at two temperatures, namely at a low and at a high temperature.

Flash Point.—The flash point determines the temperatures at which oil discharges by distillation a vapor which may be ignited. The test may be performed in an open or a closed vessel, the open vessel being preferable, as it reduces the likelihood of explosion, at the same time rendering more uniform results. To determine the flash point the oil, in which a thermometer bulb is suspended, is heated in a sand-bath or its equivalent. At elevated temperatures a match is passed over, and about 0.5 inches above, the surface of the oil, at frequent intervals. The temperature at which the oil flashes is the flash point.

Burning Point.—The burning point is determined in the same way as the flash point only that the temperature is increased until the oil vapor above the oil burns continuously.

Chill Point.—The chill point indicates the behavior of oils at low temperatures. It is the temperature of solidification. A freezing mixture of ice and salt surrounds the oil in which a thermometer is inserted. When the oil has congealed remove it from the influence of the freezing mixture. Stir gently with the thermometer until the oil is melted, when the temperature indicated is the chill point. A large number of oils, unlike water which freezes and thaws suddenly, soften slowly until running occurs the temperature rising meanwhile, which makes it difficult to determine the chill point with any very great accuracy. The temperature indicated when the oil has attained sufficient fluidity to run slowly should be taken as the chill point.

Evaportion.—This is a very useful test, although the results obtained by different individuals rarely correspond. A number of ways are in vogue for performing this test. One method is to saturate filter paper with oil and weigh before and after heating. With this method the weight of oil is so small that great care must be exercised. A better method is to fill a vessel with a definite weight of oil and heat, the oil being weighed again after heating, from which the loss due to evaporation is immediately obtained. As can easily be seen, in this test the amount of evaporation, for a given temperature, depends upon the amount of area of the oil exposed to the atmosphere. About 5.00 grams of oil heated for five hours at 110° and then weighed, then heated again for another hour before the final weighing, has been found to give very satisfactory results. The vessel used should be preferably of brass, of a diameter of about 3 cm. and a depth of 3 cm.

Volatility.—There are certain oils which gain weight by absorbing oxygen, others lose weight. This test usually consists of heating a given weight of oil for a definite length of time and weighing before and after.

Durability.—Upon the durability or endurance of an oil depends its ability to lubricate for any length of time without becoming gummy, and increasing the coefficient of friction. The test for durability is performed by a durability-testing machine. Durability is sometimes expressed according to the increase of the coefficient of friction, and sometimes according to the number of revolutions of the test spindle required to raise the temperature of the oil

under test to a certain temperature. Uniform results are hard to obtain in this test, for which reason a number of runs should be made, and the final result taken as the average of all the individual results.

COEFFICIENT OF FRICTION.—The coefficient of friction is the ratio of the limiting friction to the normal reaction. This test is quite an important one, which, no doubt accounts for the many different makes of machines—of varying types—on the market for carrying out this test. All these machines are nothing more than dynamometers which measure the input and output, from which the friction is obtained.

The more simple tests here described can readily be performed by the average central-station without any very complete laboratory equipment. On the other hand those tests requiring special machines also require expert handling, if the results are to be of any value. As the testing of materials is a purely commercial matter in that materials are tested to save money, it follows that it would not be a good investment to spend much money on expensive machines unless the return were good. Expressed in another way, if a large quantity of oil is to be tested and such occurs frequently it might pay to perform all the tests mentioned above. For the majority of central-station companies the simpler of the tests will suffice.

I. L. Kentish-Rankin.

Questions and Answers from Readers

Readers are invited to make liberal use of this department for discussing questions, obtaining information, opinions or experiences from other readers. Discussions and criticisms on answers to questions are solicited. However, editors are not responsible for correctness of statements of opinion or fact in discussions. All published answers and discussions are paid for.

Polarities of Transformers.

Editor Electrical Engineering:

(527) In the 1913 report of the N. E. L. A. committee on meters the accompanying diagram is shown with the following comment:

"There is no uniformity of practice among manufacturers regarding the relative instantaneous polarities between primary and secondary windings of current and voltage transformers. For instance certain manufacturers design transformers as shown by sketch No. 1 of Fig. 1, and others as shown by sketch No. 2 of Fig. 1. Further on some transformers, no markings are placed on the terminals to indicate instantaneous polarities. The terminals on all instrument transformers should be arranged alike as regards instantaneous polarities and the connections represented by sketch No. 2 of Fig. 1 are recommended as preferable."

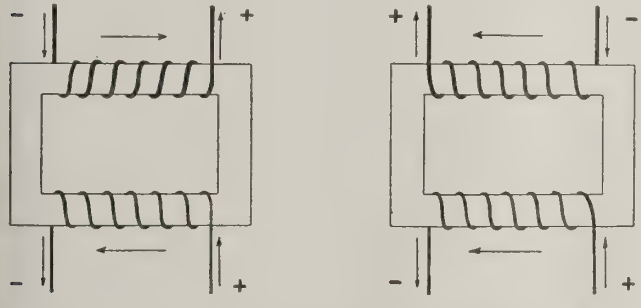


FIG. 1. DIAGRAM SHOWING TWO METHODS OF TRANSFORMER CONSTRUCTION.

Will some reader explain why sketch No. 2 is preferable, and also give the names of companies that make instrument transformers with windings arranged as shown in sketches No. 1 and 2? W. T. R.

Three-Phas, 4-Wire Circuit.

Editor Electrical Engineering:

(528) What are the advantages of the 4-wire, three-phase circuit over the 3-wire, three-phase circuit? What is the use of the fourth wire? F. E. G.

Reactance and Choke Coils.

Editor Electrical Engineering:

(529) It appears to the writer that the terms "reactance coil" and "choke coil" refer to devices that are in principle the same. If this is true, why are the two terms used? H. W. R.

Use of a Synchronous Motor for Power-Factor Correction.

Editor Electrical Engineering:

(530) Please explain how it is that a synchronous motor used for correcting the powerfactor of a transmission line can at the same time carry a load as a motor? It would seem in this case that a lagging current is taken from the line and a leading current furnished at the same time. How is this possible, if true? W. J. R.

Grounding Transformer Coils.

Ed tor Electrical Engineering:

(531) Is the grounding of transformer cases a precaution only for safety of workmen or will such grounding prevent damage to transformers from lightning?

H. E. M.

Steam Plant Operating Costs.

Editor Electrical Engineering:

(532) What percentage of the total operating costs of small steam plants should coal, labor, oil and waste and repair costs be to be considered fair for good operation? Plants of from 200 to 1000 Hp. of both engine and turbine types are referred to. J. A. B.

Static Discharge from Belts.

Editor Electrical Engineering:

(533) Is there any danger of damage to an induction motor from the static electricity generated on a large belt connecting such a motor to a line shaft? The static discharge is considerable. What effect does this static have, if any, on the belt friction? E.C.T.

Locating Blown Potential Transformer Fuses, Ans. Ques. No. 503.

Editor Electrical Engineering:

The easiest way to locate a blown fuse in the potential circuit is to mount two receptacles on a small board with

three contacts arranged on the edge of the board in such a way as to span the terminals of the secondary of the potential transformer. By applying this board to the terminals, two 10-watt tungsten lamps placed in the receptacles will glow with full brilliancy if the fuses are good. If one fuse is out on either of the other lines one of these lamps will be out. If the central fuse is out the two lamps will both glow at half brilliancy. Where the installation is rather large it might pay to put in a pair of receptacles for each pair of potential transformers, and connect them up permanently, one across the secondary of each potential transformer. If these transformers are all of fairly large capacity, say 100 watts each, the lamps can be allowed to burn all the time, thus showing at a glance which fuse is at fault, but if the transformers in use are of 50 watt capacity they are probably already fully loaded by the watt-hour meters, in which case you would not care to add the 10 watt lamp load. In this case one can screw the lamp out of the socket except at such times when a test is needed.

Direct Connected vs. Belted Generators, Ans. Ques. No. 505.

The engineering arguments in favor of the direct connected over a belted generator are chiefly limited to the saving in floor space and the slight gain in efficiency due to the absence of belt slippage. The belted type of generator presents decided advantages when used in small units, because of the fact that it can be built for higher speeds. Any one familiar with prices of induction motors will realize the wide difference between a high speed motor and a low speed motor. The same condition exists with generators. A direct connected generator is rarely built for a higher speed than 300 r.p.m., whereas the belted type generator can be built for 600, 720, 900, and 1200; all of which will show a corresponding saving in the first cost. The operating efficiency is somewhat better with the direct connected machine, but the saving in investment is decidedly in favor of the belted type.

Why Disconnecting Switches Open on Short Circuit, Ans. Ques. No. 506.

The reason why the disconnecting switches in the station mentioned were forced open by a short circuit is that there is a very considerable force exerted between two parallel conductors which have large currents flowing through them. In the case of a short circuit of 20,000 amperes, with a distance of 4 inches between the conductors, the force exerted between them is about 70 pounds per lineal foot. So it is easy to see that even a moderate short circuit might cause a pressure on the switch of 15 or 20 pounds which would be amply sufficient to force it open, unless it is furnished with some type of lock. Disconnecting switches which can be locked in place are now on the market, and will prevent the occurrence mentioned. In the case of the bus bars, the same thing is true. The force exerted between the bar in question and other adjacent circuits may reach several hundred pounds per lineal foot which is together sufficient to twist the bars out of shape. G. B. McNair.

Demagnetizing a Watch. Ans. Ques. No. 508.

Editor Electrical Engineering:

A very good method for demagnetizing a watch is to provide a coil of wire about 6 inches in diameter, with its axis vertical, through which an alternating current having a frequency of about 60 cycles per second may pass.

The watch to be demagnetized should be attached at the ring in its stem to a string about two feet long, and suspended like a plumb bob in the center of the coil. While the watch is in the center of the coil, cause it to revolve rapidly about its vertical suspension string as an axis and turn the alternating current into the coil. While the watch is revolving, raise it slowly out of the center of the coil, to a height of about two feet.

To successfully demagnetize a watch by this method, the maximum strength of the alternating field produced by the coil must be as great as the field that produced the magnetization of the watch. If the watch should be placed in the coil, and the alternating current flow be interrupted by opening a controlling switch, the alternating-current flow might be stopped when the direction of the alternating-field is the same as that of the field producing the original magnetization, leaving the watch still magnetized. The watch should therefore be removed from the coil while the current is still on. Prof. F. E. Austin.

Why Generators Would Not Build Up, Ans. Ques. No. 509.

Editor Electrical Engineering:

The remedy I should try with the generator referred to by J. F. B. is to reverse the shunt field winding and open the main switch. If the polarity of the shunt field is not correct, the current produced in it due to the residual magnetism, will set up a magnetic field that will oppose and weaken the residual field, which must be present in order for the dynamo to pick up.

The fact that the fuse is blown when the series winding and armature are short-circuited, indicates that the armature winding is not faulty. Under normal conditions a dynamo will build-up under load, but if it has been standing idle for a long time or if it is a new machine being started for the first time, the main switch should be open. Under these conditions the shunt field will receive all of the current developed by the residual magnetism which is usually weak. Also if the shunt coils are burnt out the generator will refuse to pick up, although the armature and series coils may be in good condition.

Corona and Skin Effect, Ans. Ques. No. 512.

In an electrostatic field between two parallel plates or between spheres of a diameter of 1.5 or more times their distance apart with gradual rising voltage, the spark occurs when the disruptive voltage is reached, without being preceded at lower voltage by any phenomenon. If, however, the electrostatic field is not uniform, (as between needle points or small spheres) with an increasing voltage the disruptive strength of the gas is exceeded at those places where the field intensity is the lightest, as at the needle points, before the disruptive voltage of the spark gap is reached, and then a partial breakdown occurs at the point of maximum field intensity, at the needle points or at the surface of high potential conductors, etc. A blue glow then appears at the needle points followed by violet streamers (in air, the color being the nitrogen spectrum; in other gases other colors appear), and gradually increase in extent with increasing voltage. This is the so-called "brush discharge" or "corona." Between needle points the brush discharges increase in extent and approaches each other until they bridge nearly 60 per cent of the gap, when the static spark occurs.

SKIN EFFECT—If we assume a wire to be made up of elementary filaments parallel to its length, it is evident that the filament at the center will be in a magnetic field of greater density than the filament at the surface, as each filament produces a field around itself. When a steady current is flowing there is no variation in the magnetic field. But in the case of an alternating current, the additional magnetic lines that inclose the central filament, reversing twice each cycle, tend to produce a higher back emf. of self induction at the center of the conductor than at the surface. This causes the current density to be greater at the surface or skin than in the inner filaments. With high frequencies and large conductors this effect may be so great that no current will flow at the center. This "skin effect" increases the voltage drop and energy loss, and has to be considered with the true resistance. With conductors of 250,000 C. M. and less on power and high circuits the loss seldom amount to 3 per cent.

L. Rutkin.

Inductive Shunts in Rotary Converters, Ans. Ques. No. 510—(1).

Editor Electrical Engineering:

The coil referred to by G. D. K. in question 510—(1) is an inductive shunt, and connected in parallel with the interpoles. Its function is the same as that of the ordinary shunt, the only difference being that the one is highly inductive, whereas the other is of very low, in fact negligible inductance. With any direct current generator or rotary converter which utilizes commutating poles, it is necessary if the best possible commutation is to be obtained, that the ampere-turns on the commutating poles increase and decrease in proportion to the ampere-turns on the armature, provided of course that the poles are not saturated. To accomplish this the interpoles are connected in series with the armature in order that the current passing through the armature also passes through the interpole winding, thereby making the ampere-turns proportional to one another.

Just what percentage of the armature ampere-turns are required on the interpoles to give the best commutating characteristics depends upon the design of the machine, and it may be and frequently is necessary to shunt a portion of the current passing through the interpole, in order that good commutation may accrue. For example, suppose the design of a machine calls for 1.7 turns per pole. It is not practical to wind for this number of turns so two turns would be used, the current corresponding to the excess ampere-turns being shunted out by a shunt. If an ordinary shunt be used for this purpose, similar to those used to parallel the series windings of machines where it is desired to simply obtain a compounding effect, and consisting of iron grids, the circuit will be practically non-inductive, whereas the circuit comprising the interpoles is of high inductance. Under these conditions, at the sudden load change, the current will divide very unevenly, the major portion going through the shunt instead of through the interpole. The result is that the interpole ampere-turns cease to be proportional to the armature ampere-turns just at the time when they are most needed to assist commutation—namely at the time when the current changes suddenly. Of course, as soon as the current becomes steady again, at whatever load, the interpoles will once more have ampere-turns proportional to those on the armature. It is only during the sudden change of current that the inductance of the interpoles have a deleterious effect. By the use of an inductive shunt it is possible to effect good commutation under normal conditions and still be able to take care of sudden load changes by adjustment of the reactance of the shunt. In fact the reactance can be made so high that an excess current can be passed through the interpole at the first instant of change of current, if so desired.

It can thus be seen that the inductive shunt finds its greatest application on machines where unsteady loads having violent fluctuations are to be expected. Such loads are chiefly to be found in railway and hoist work. A number o finductive shunts have been installed on some of the largest rotaries supplying power for street railways but in such cases the load is so steady and the peaks of so little account that they are really not required. On the other hand, for interurban service, where the load is spasmodic, and of very high swings of current, these inductive shunts are very useful indeed.

I. L. K. Rankin.

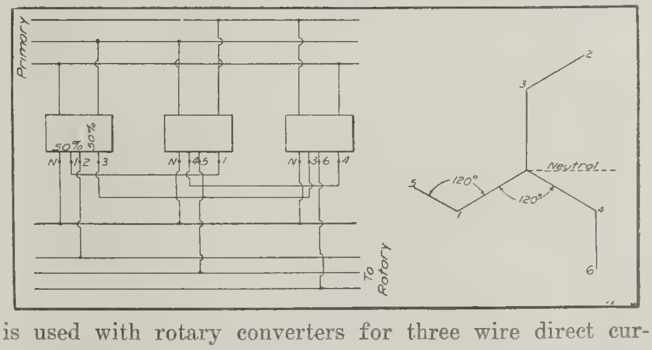
Inductive Shunts in Rotary Converters, Ans. Ques. 510-1.

Editor Electrical Engineering:

Generators and rotary converters with commutating poles in which it is not desirable to pass the full armature current through the commutating field coils, are provided with a shunt to the commutating field to take part of the current. In as much as the commutating field has a certain amount of self-induction in order to take care of sudden changes in load, its shunt must likewise be inductive also for otherwise the field current would not vary with the total current.

Interconnected Star Connection for Transformers, Ans. Ques. No. 510-2.

The diagram shown here gives the interconnected or distributed star connection for transformers. This connection



is used with rotary converters for three wire direct current service to balance the neutral current in all three phases of the A C side instead of drawing an unbalanced current from all three phases in succession as in the straight star connection. The primary connection may be delta or star.

H. A. Davis.

Inductive Shunts in Rotary Converters, Ans. Ques. No. 510-1.

Editor Electrical Engineering:

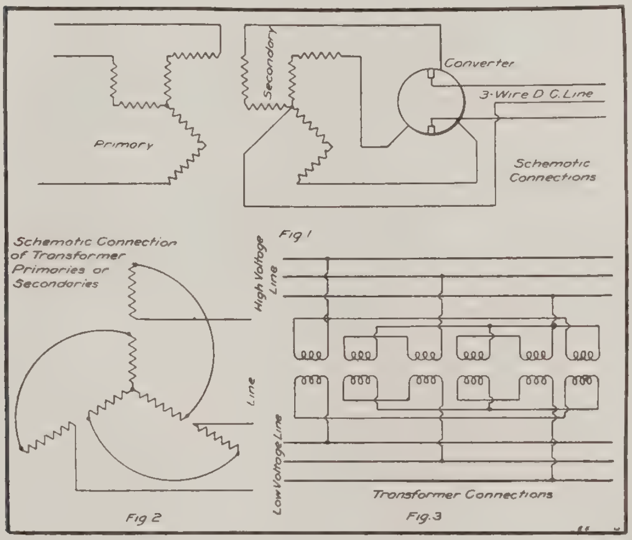
Sometimes on commutating pole machines such as motors, converters, etc., a shunt is used for the purpose of regulating the effect of the commutating poles. The principle is the same as that of using a shunt around the series field. There is one important difference, however. The

commutating poles are in series with the armature so that the current through them varies directly with the load. This is a necessary condition for good action of the commutating pole.

Suppose that a plain resistance is shunted around the commutating poles. The current through them will still vary directly with the armature current and will be a definite proportion of it. If, however, the armature current takes a sudden jump the current cannot increase as fast through the commutating poles due to their inductance so that they act like choke coils and force the greater part of the current rush through the shunt resistance where it does no good as far as the commutation of the machine is concerned and poor commutation with quickly varying loads is liable to result. To overcome this difficulty the shunt is made in the form of a coil whose inductance is the same as that of the commutating poles. Now when the current takes a sudden jump it is as hard for it to get through the shunt as through the commutating poles so that each gets its proper proportion of current. In many cases these inductive shunts are omitted and adjustment of the strength of the commutating poles is obtained by some other means such as changing the air gap.

The Interconnected Star Transformer Connection, Ans. Ques. No. 510-2.

The interconnected star transformer connection is commonly used for converters which supply three wire systems on the d. c. side. The neutral of the three-wire system is in this case connected to the neutral of the transformers.



This connection is used in preference to a straight star because it has been found to give better regulation of voltage. It is made by putting half the winding of one transformer in series with half that of another as shown in Fig. 3. Instead of interconnecting both primary and secondary either may be connected in delta.

Operation of Rotary Converters, Ans. Ques. No. 519.

The main reason for operating converters at unity power factor is to eleminate useless heating. The effect of low power factor on efficiency is unimportant relative to its effect on the heating which increases rapidly as the power factor varies from unity. The power factor of a converter is adjusted by changing the shunt field excitation the same as with a synchronous motor. This is most easily done by reducing the field rheostat resistance when more excitation is desired.

If a power factor meter is available it is very simple to adjust the field. If the power factor is lagging the field strength should be increased, if leading it should be decreased until the power factor is brought to 100. If no power factor meter is available the ammeter on the a. c. side can be used. The converter will take a minimum current when it is operating at unity power factor. To adjust the converter, change the field rheostat and note whether the a. c. ammeter reading increases or decreases. If it increases the rheostat was turned the wrong way and should be turned back in the other direction. Keep turning in this direction till the current stops decreasing and begins to increase again. At this point it will be found that turning the rheostat in either direction will increase the current. This is the proper setting, for the current is a minimum which means that the converter is operating at unity power factor.

The above method of adjustment applies to ordinary shunt wound converters where the load is fairly constant so that current variations can be checked. For railway service a compound converter is frequently used. The above method can only be applied in case the converter is not in parallel with others and even then the d. c. voltage of the machine will be changed by changing the field. With compound converters in parallel the diversion of load is affected by changing the field since this changes the normal voltage so that power factor adjustment by field variation is not used. The voltage is adjusted to its proper value and the power factor has to take care of itself.

R. H. Willard.

Inductive Shunts in Rotary Converters, Ans. Ques. No. 510—(1).

Editor Electrical Engineering:

The coil referred to in paragraph No. 1 of question 510, is an inductance coil or inductive shunt, placed across the commutating pole winding the same as it would be with a direct current generator. Communtating pole windings are often provided with more turns than are necessary to provide sparkless commutation, or when it is impossible to provide the exact number of amp turns, it becomes necessary to shunt the excess through a German silver shunt wound inductivity on an iron core or an additional coil of copper wire having inductance connected in series with the German silver shunt.

Rapid voltage fluctuations would cause the current through the commutating pole winding to lag due to its inductance, and a large portion of the current would pass through the German silver shunt if it did not possess a higher inductance than this field, or were not connected in series with an inductance coil. Adding communtating poles permits the construction of a smaller machine for a given output and the capacity of a machine may be increased, as the commutation is better.

Lubricating Oil Tests, Ans. Ques. No. 510—(4).

The extent of a test on lubricating oils depends upon the particular purpose to which the oil is to be applied, or the information sought. The ideal oil is one that has the greatest adhesion to surfaces and the least cohesion among its own particles, hence the determination of its body or viscosity is of prime importance.

The term viscosity as applied to oil, is the time required for a given amount at a certain temperature to pass

through an aperture of given size. A simple way of determining the comparative viscosities of different oils is to have equal amounts of the different oils at the same temperature, in similar receptacles, provided with uniform openings and noting which oil requires the longest time to drain from the receptacle. This would be the oil of greatest viscosity.

Oils may be of beautiful color to the eye and good viscosity, yet if the gravity is taken and found to be low, say 20 to 23 Beaume, the oil is too heavy or has too much body, or gum, resulting in carbonizing, if the oil is used for gas engine lubrication. An oil that shows more than 4 per cent evaporation is not considered a good lubricant, because the fast evaporation will leave the base or gum, which will cake and carbonize.

To determine the lightest oil, pour equal amounts of the samples under test on clean blotters. The thinnest oil will spread furthest and evaporate the quickest.

The cold test is the temperature at which an oil will just flow. It demonstrates the ability of the oil under test to remain fluid on exposure to low temperatures. Ice and salt are used as a freezing mixture, the stopper of the bottle containing oil under test having a thermometer passed through it, and immersed in the oil.

A low flash and fire oil is unsuited for gas engine lubrication. Cylinder oils should have a high flash point. The flash point of an oil is that temperature at which vapor given off from the oil mixed with air will ignite, and fire point that temperature at which the mixture of oil vapor and air when ignited will burn continuously. The flash point of an oil must be given consideration in surroundings when fire risk is great.

P. Justus.

Interconnected Star Connection for Transformers, Ans. Ques. No. 510-2.

Editor Electrical Engineering:

The interconnected star connection refers to a bank of transformers connected in star, in which the primary or secondary windings are in two separate section, and so connected that the currents flowing in the two halves are 180° out of phase with one another.

Transformers with two separate windings in the secondary may be connected in either delta or in star, although the former is the more common. Fig. 1 shows a bank of transformers with the primary connected in star and the secondary in double star; and Fig. 2 shows a vector diagram giving the voltage and current relations in the secondary. An examination of this latter diagram shows that the currents in the two halves of the secondary windings are in opposition. On account of this phase displacement of the currents in the two halves of the windings there is a loss in capacity, the loss being 15.5 per cent. To take care of this it is customary to use a larger secondary winding, or primary as the case may be, when a transformer is designed for this connection.

The interconnected star connection is almost solely used in connection with rotary converters, where it is desired to use a neutral on the transformers and on the direct current three-wire system. The reason for using this connection is to prevent the direct current from causing the magnetic circuit becoming greatly unbalanced. With direct current flowing the magnetic circuit would be highly saturated at one maximum of the alternating current and but slightly so in the reverse direction. By arranging the secondary coils of each phase in opposition, the currents counterbalance one another and the magnetizing effect is zero.

There is one other application of the interconnected star connection, and that is for use with delta connected generators or transformers where it is desired to obtain a neutral. In this case auto-transformers are used. Here also there is a loss in transformer capacity, and the interconnected winding must have an increase of 15.5 to take care of the phase displacement of current.

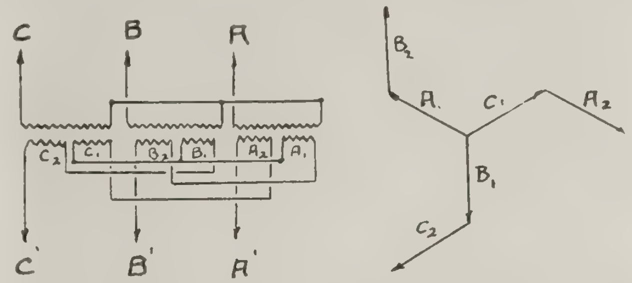


FIG. 1. THE INTERCONNECTED STAR CONNECTION, AND VECTOR DIAGRAM.

Choke Coils of Iron Wire, Ans. Ques. No. 510-3.

Choke coils of iron wire are not superior to copper, for if such were the case coils of iron would be gladly welcomed by central-station companies throughout the country, and their use would become universal instead of being a rarity as they are at present.

At first thought it appears reasonable to expect that iron would be much more effective than copper for protecting apparatus against high-frequency surges on account of its magnetic properties. That it is not so has been amply demonstrated in practice, and the reason is quite simple to understand.

For an iron coil to be superior to one of copper it is necessary that its reactance and effective resistance be higher at high frequencies, and the hysteresis loss in the iron must be much greater than at normal frequencies. At normal frequencies there is considerable skin effect in iron wire, a comparatively small portion of current flowing through the inner section of the conductor, the major portion flowing thrugh the outer shell. At very high frequencies the current penetration is less than at commercial frequencies, very much less, and thus the volume of iron available for use for hysteresis is greatly reduced. With current of normal frequency flowing, there is a tendency for the high-frequency current to be still further shunted out to the outer shell of the conductor, thereby reducing the hysteresis still further.

The behavior of iron at high frequencies has been fully treated by Chas. P. Steinmetz in "Transient Phenomena" and by E. F. W. Alexanderson in the A. I. E. E. Trans for 1911, Part III, in a paper entitled "Magnetic Properties of Iron at Frequencies up to 200,000."

I. L. K. Rankin.

Skin Effect and Corona, Ans. Ques. No. 512.

Editor Electrical Engineering:

An alternating current flowing in a wire or cable or other conductor sets up a magnetic flux both outside and inside the conductor. The internal flux acting on the current causes the current density over the cross-section of the conductor to be non-uniform, the higher current density being nearest the surface. This interferes with the free

flow of current over the conductor results in a seeming increase in resistance to the flow of alternating current, the increase in resistance becoming greater with increase of frequency. The above described phenomena is called "skin effect."

The resistance of a conductor to alternating currents may be calculated, but the formulae necessary are rather complicated. The increase in resistance due to skin effect, over the resistance to direct currents is less than 1% for 60 cycle currents in copper cables up to 300,000 circular mils. With aluminum conductors, as with copper, skin effect is inappreciable except in the larger sizes. When the conductor is of iron or partly iron, the skin effect is much greater and where calculations for such conductors are made, tables should be consulted and the skin effect factor taken into consideration.

When the refinements of the calculation require the skin effect to be taken into consideration, there are numerous tables published in handbooks and other sources of information from which the A. C. resistance may be taken. The following figures, taken from Dwight's, "Transmission Line Formulas" will give an idea of the comparative resistances of copper wire and cable to direct and alternating currents:

B & S Gage or Cir. Mils.	Res. Per Mile D. C.	-60 A. C. Cycle	% Increase A. C. Over D. C.
2	.8550	.8554	.004
0	.5379	.5385	.11
2/0	.4264	.4271	.17
4/0	.2682	.2693	.43
300,000	.1892	.1908	.85
350,000	.1621	.1640	1.16
450,000	.1261	.1285	1.9
500,000	.1135	.1162	2.34

Corona Lines of electrostatic flux issue from any charged conductor and pass into the surrounding medium. The density of this flux is dependent upon the voltage or potential to which the conductor is charged. The higher the potential the greater is the density of the field of electrostatic flux. The ability of any insulating medium to insulate, or restrict the charge to the conductor, is dependent upon its strength to resist the stresses set up in it by this flux, and these stresses are meaured by the density of the field of electrostatic flux in the medium.

When the insulating medium, or dielectric, is air and the electric potential (and therewith the electrostatic flux density) is increased, the air particles become charged or ionized. In this condition the air begins to become conducting. On increasing the voltage still higher, a point is reached where the air in the immediate neighborhood of the conductor begins to glow with a faint red-violet color. This glow is called visual corona. The actual corona begins when the voltage gets high enough to ionize the air surrounding the conductor. As energy is required to cause the ionization of the air, the production of corona indicates a loss of energy.

The production of corona is dependent upon a number of factors, among them being the following: 1. Size of conductor; a small conductor showing corona at a lower voltage than a larger one. 2. Separation of wires; small separation tending to cause corona at lower voltages. 3. Temperature and atmospheric pressure; high temperature and low pressure lowering the critical voltage at which corona begins. The material of the conductor has no effect on the production of corona. F. B. Davenport.

Corona and Skin Effects. Ans. Ques. No. 512.

Editor Electrical Engineering:

Corona is the name given to the violet-white brush discharge which surrounds a conductor carrying high potential when the voltage gradient at the surface of the conductor reaches a certain density, which is known as the critical voltage. If the voltage at the surface of a conductor be increased, the surrounding air becomes ionized, the molecules of the air break up into atoms, and the air becomes conducting.

Since corona depends upon the intensity of the electric field or stress, it follows that corona may be eliminated by increasing the diameter of the conductors, reducing sharp bends and corners. By increasing the diameter of the conductor the potential gradient is likewise decreased, and the electric field ceases to exert a force sufficiently strong to overcome the forces holding the atoms together and corona will cease to exist.

Corona is to be avoided because it absorbs power, and produces ozone, nitrous oxide and nitric acid, which attacks metals and insulating materials, frequently resulting in their rapid disintegration and decay. It has been suggested that corona be made use of on high-voltage lines as a safety valve, in this way. If a line be operated very close to the critical voltage (for forming corona), and should any voltage rise occur, due to switching, etc., corona will immediately take place, and will absorb power, thereby dissipating and damping out the oscillations and surges of steep wave front. It is thought, however, that this mode of protecting a line from potential rises is open to a very limited application only. For a given voltage, corona is affected by the diameter of the wire, its spacing, and the temperature of the air and barometric pressure.

SKIN EFFECT. Skin effect is the tendency of rapidly alternating currents to avoid the central portions of solid conductors and flow for the greater part through the superficial portions. Skin effect is independent of voltage, but depends upon the cross section, shape, specific resistance and permeability of the conductor, the shape of the circuit, and the frequency of the current.

Skin effect is often spoken of as the effective resistance since it is in effect the equivalent of true ohmic resistance. For large conductors it is often necessary to take skin effect into consideration because if the current is very heavy and the conductor be not suitably subdivided, the voltage drop due to the skin effect may be a value comparable with the true ohmic resistance. In such cases it is necessary to make use of a "skin effect factor" which is the factor by which the true ohmic resistance (resistance to direct current) must be multiplied to give the drop with alternating current.

It will be seen that corona and skin effect are two obsolutely different phenomena. The one is entirely dependent upon voltage, current not entering; whereas the other is dependent upon current entirely, and independent of voltage. I. L. K. Rankin.

Action of Partial Ground on Street Railway System, Ans. Ques. No. 513.

Editor Electrical Engineering:

The following is a discussion of Question No. 513 of the March issue of *Electrical Engineering.* In the case of a ground on a trolley wire of a street railway caused by a defective insulator or a feeder being against a limb, etc., the

leakage depends on the resistance of the ground, and the voltage at that point. If the voltage at the power house is supposed to remain constant, the voltage at the ground and, therefore, the leakage would decrease with the load.

Take the case of a defective insulator on a line one mile from the power-house, the resistance which is found to be 110 ohms. The voltage at this point is assumed to be 590 volts at light load. The leakage would then be ($C = E \div R$) or $590 = 110$ or 5.3 amperes. At heavy load the voltage at the age would then be $580 \div 110$ or 5.2 amperes.

However, the leakage from the rails to the ground and to pipes along the rails would increase as the load increases. For instance, suppose a pipe line to approach close to the rails at a point one mile from the power-house and again at the power-house. The resistance of one mile of 60 pound rails is .004 ohms. Suppose the resistance from the rails to the pipe and back to the rails again at the power-house to be 4.4 ohms. The current flowing back to the power-house would divide between these two paths according to their respective resistance. If the line load was 100 amperes then 99.0 amperes would flow in the rails and 1.00 ampere in the pipe. If the line load increased to 500 amperes the leakage would be 5.0 amperes.

It may be readily seen that this leakage might be enough to cause considerable damage to the pipe line through electrolysis in case the trolley line crossed the pipe line and then recrossed it after making a detour, for the resistance from the rails to the pipe line and back again to the rails would be decreased relatively to the resistance of the rails.

R. A. Jones.

Grounding of Conduit, Ans. Ques. No. 517.

Editor Electrical Engineering:

Where short sections of conduit are used to protect portions of exposed wiring such as where wires go through walls or floors and in running to motors on the floor, the installation of conduit without grounding is passed by the underwriters. Such sections are seldom more than 10 feet long and are for mechanical protection.

Selection of Brushes for Generators, Ans. Ques. No. 518.

The writer's experience with 600 volt generators and rotary converters has indicated that with slotted commutators a softer brush may be used, also less tension, thus saving wear of both commutator and brushes. On two rotary converters in particular which were subject to heavy and sudden loads causing frequent flashovers before slotting, a great improvement was noticed. Since slotting a flashover is a comparative rarity. These machines are in use on an interurban trolley road.

Operation of Rotary Converter, Ans. Ques. No. 519.

All electrical machinery should be run as near unity power factor as possible both to keep down heating and energy loss. Rotary converters will run at power factors as low as 50 per cent at least, as I discovered once when called in to find out why a converter would not build up voltage. It was found that the voltage of the direct current side was about 575 when the machine was last used instead of 650. An open circuit was found in the shunt field, the machine having run for a considerable time on the series field alone. Of course after shutting down it was not possible to start again as the machine had to be started with a motor and synchronized. It would be interesting to know the actual power factor but no definite data was at hand to obtain it.

If no power factor indicator is available the power factor may be approximately obtained by comparing the input and output. Another way to adjust to approximately unity power factor is to first open the direct current switches to cut off the load, then while the converter is floating turn the rheostat until a good deflection is obtained on the A. C. ammeter, say two hundred amperes on a 300 Kw. machine. Then turn rheostat in opposite direction until same reading is obtained. Intermediate between these points is about unity power factor. Cutting out a small amount more of resistance will in a measure assure that the power factor is not lagging. This is, of course, only approximate but is a better indication than nothing.

Henry A. Davis.

Grounding of Circuit, Ans. Ques. No. 517.

Editor Electrical Engineering:

The short pieces of conduit (or pipe of equal strength), referred to by National Electric code, section 26, Rule E, refer to short pieces of iron pipe used for mechanical protection where the wires pass through a brick wall, etc. It should be noted that each wire must be separated from the other wires and from the pipe by an approved flexible sleeve. (This refers to loom or its equal).

The reason for grounding conduit is to prevent a difference of potential between the conduit and ground, in case a wire is stripped in pulling in, or in case of defective insulation. With the flexible sleeve referred to, there is no danger of a ground. It would be prohibitive to insulate each separate wire in an extensive conduit system, and in most cases it is not convenient to ground the short pieces of pipe used for mechanical protection.

Operation of Rotary Converter, Ans. Ques. No. 519.

The principal reason for operating a rotary converter at 100 per cent power factor, is to reduce heating of the armature. There is also an advantage in increased efficiency. If no power factor meter is available, the next best method is to adjust the shunt field excitation so as to obtain the lowest reading on the A. C. ammeters. The adjustment being made, of course, at some time when the load is constant. If the load is varying rapidly, as is usually the case with a rotary supplying a street railway, it may be necessary to make adjustments at no load.

If the rotary is compound wound, the series field will take care of the power factor with change of load, once the shunt field is properly adjusted.

Grounding of 3-Wire, 110-220 Volt Systems, Ans. Ques. No. 520.

With the neutral grounded on a 220 volt D. C. system, or an A. C. system without transformers, the maximum voltage possible between any wire and the ground is one-half of the line voltage, or 110 volts. The maximum voltage possible between any wire and ground on an ungrounded system, is full line voltage or 220 volts in this case.

In case transformers are used to step down from a higher voltage, the highest voltage possible on an ungrounded system, from any wire to ground, is the sum of the high and low voltage. This is in case of ground between high and low tension windings. With grounded neutral, the highest possible voltage is one-half of the line voltage, or 110 volts. The reason for grounding therefore, is to keep down voltage stress from circuit to ground to the lowest voltage possible.

B. L. Cathey.

ELECTRICAL ENGINEERING

DANIEL H. BRAYMER, Editor.

Devoted to the generation, transmission and distribution of electrical energy for lighting, heating, power and traction. Correspondence suitable for the pages of ELECTRICAL ENGINEERING is solicited and paid for. Name and address of correspondents must be given,—not necessarily for publication.

Published monthly by the W. R. C. SMITH PUBLISHING CO., at Dalton, Ga.; editorial and advertising departments, Grant Building, Atlanta, Ga. Entered as second-class matter at the postoffice at Dalton, Ga. Subscription rate $1.00 for two years; Canada $1.00 a year; foreign $1.50 a year.

Vol. 47. JUNE, 1915. No. 6

CONTENTS.

The electric light, power and railway systems of this country employ more than 360,000 men.

The capital invested by electric light and power companies was $1,096,913,622 in 1907 and has been more than doubled since.

One hundred and eighteen leading public utility companies operating in the U. S. reported earnings for the year 1914 showing about 3.9 per cent increase in gross earnings despite the general industrial depression. Net earnings in the same period increased 4.7 per cent.

Of the 1,543,464,097 kilowatt-hours produced by certain Canadian hydroelectric plants in 1913, 772,597,049 kilowatt-hours were used in the United States.

It is claimed that the annual spoilage in American manufacturing plants is valued at $150,000,000, seventy-five per cent occurring under poor artificial light. With good lighting this loss can be reduced twenty-five per cent, it is said.

If true, $37,500,000 would buy a lot of tungsten lamps and efficient reflectors and plant managers should investigate this matter.

The N. E. L. A. Convention.

As this issue goes to press, special trains are on their way to the Pacific Coast carrying delegates to the thirty-eighth convention of the National Electric Light Association to be held at San Francisco on the 7th to 11th of this month. In our last issue we published the program for this convention presenting some 80 reports and papers to be read and discussed at 15 sessions. With these sessions about three hours long and an average of something better than five reports and papers assigned to each, it is certain that time will not drag and that whatever is said in discussion will represent the crytallized opinions of the best thinkers in the central station field for there will be hardly time for any others to get their thoughts together.

The National Electric Light Association convention is now looked to by executives and operators in the field of generation and distribution of electrical energy as the all important event of the year and the four volumes of proceedings on general, technical, commercial and accounting subjects issued each year of around 1800 to 2000 pages certainly justify this opinion. These volumes are a yearly encyclopedia of progress in design, engineering and commercial lines covering all phases of the central station field. It is in part due to the work of this association and the spirit of cooperation created by it among its 12,300 members that the industry, although young, has advanced in such rapid strides until at the present time there is hardly a nook or corner of this whole country that is not served with light and power from a central generating source.

The proceedings of the San Francisco convention will be abstracted in considerable detail in the columns of our next issue.

Engineering English.

It is often said that an engineer is a poor writer and poor public speaker. There is one logical reason for and one against this impression. The engineer who is a master of engineering problems approaches and treats engineering topics in an analytical manner. His writings and his discourses for the most part are in mathematical language embodying and referring to theoretical principles of his profession. The laws of nature and the theories of science are matters that do not lend themselves to flowery verbage and the voice inflections that characterize the discourses of some so-called good writers and famed orators. From this standpoint, the engineer, as such, can never hope for a position in the first rank of oratorical spell-binders and authors of sensational literature.

On the other hand, however, the engineer can and should be able to write and talk on engineering topics so as to be understood by every one possessing an average

and even less than average knowledge of engineering theory, design, construction and operation. The engineer who possesses this ability is a good writer and a good speaker in every sense in which these terms are generally understood. From this standpoint there is plenty of opportunity for logical criticism of the English used by the average engineer. Like some young doctors and many young lawyers, who cover the scraps of their professional knowledge with a fluency with which they have learned to use certain technical terms of many syllables, there is a tendency on the part of some engineering writers to load their discourses with complicated mathematical statements of engineering facts and results of experience and to pay too little attention to simplification and analysis of these statements for use in practice. In other words such writers and speakers simply hit the high spots so to speak, and shoot entirely over the heads of the masses of readers and hearers who can profit most by their discourses. When an engineer does this sort of thing he displays his ignorance of human nature and the good he can do the average practical man. This is an especially serious and inexcusable fault for every engineer knows that he must depend upon the practical man of average training and mental capacity to carry out the details of his ideas in design, construction and operation. Further, he knows that these men make up the bulk of those who listen and read what he has to say and present themselves in a receptive mental attitude on account of the fact that they realize their deficiencies and credit the speaker or the writer with a superior knowledge by the very act of listening to or reading what he may have to say.

The following comment received from a reader of *Electrical Engineering* emphasizes the above remarks, and should be of interest to engineering writers:

"That I am a technical graduate does not mean much, I admit. College training has not made a wonderful engineer of me. Yet I believe I should be able to understand all the technical articles I read, especially those pertaining to subjects in my own line. Since I am a college graduate, I feel that I should be able to understand things that are written by our best technical men, but I often fail to catch the point, and I know other men of 'higher education' than myself who are in the same boat.

"Just the other day I read an article that dealt with efficiency—a subject in which I am much interested. The article was written by an able man, a well educated man, a man who holds a responsible position. However, his English and his foreign phrase insertions were away above my head. I did not get the drift of his argument clearly and so abandoned the reading. Perhaps, if the article had been written in simple words it would have proved of value to me. As it was, I turned to the more understandable things written by plain, every-day engineers who can state facts without the flourish.

"I am sure any writer who writes above the average head would like to be told of his fault, and it is for this reason that I write this comment. A college graduate should be at least an average man and writers should surely come down to the average level. I trust that everybody can understand this, whether he is illiterate, an average man, or a 'high brow.'"

The essential requirements of engineering english are, analysis of a subject into its a correlated parts, and the use of simple expressions and diction in sentences that convey one and the proper meaning. References, comparisons and analogies that are sure to come within the experience of the average practical man often serve the same purpose as illustrations and pictures in printed works. To master engineering english one must master simply the principles of good exposition and description and learn to create word pictures that are in themselves complete. All reference to actual illustrations and data or mathematical formulae should supplement and be in addition to what has been said or written, for not all men who can readily grasp ideas can visualize them and not all men can get from an illustration what is intended to be shown without an explanation.

The average reader and listener, if an engineer hungry for real information, is curious. He wants to know the whys and wherefores so that the engineering writer and lecturer who takes into consideration these simple facts not only improves his english as such by making it simple, but places his thoughts and experiences within the reach of many to whom they would otherwise mean nothing.

Leading Copper-Producing States.

Arizona stands in first place among the copper-producing states for 1914, but had a notably decreased output. The blister-copper production for 1914 will probably not exceed 380,000,000 pounds, compared with 404,000,000 pounds for 1913.

The production from Montana was the smallest for many years and probably did not greatly exceed the production of 1898, which was 206,000,000 pounds, the smallest output made by the state since 1895. In 1913 Montana produced 285,700,000 pounds.

Michigan, with a production of about 160,000,000 pounds, made a slight gain over the 155,700,000 pounds produced in 1913, but was still much below the normal output for the state.

Utah will show but little change from the 148,000,000 pounds produced in 1913.

The production from Nevada decreased from the 85,-200,000 pounds in 1913, and probably will not greatly exceed 60,000,000 pounds for 1914.

New Mexico made an increased production of probably about 10,000,000 pounds over the output of 50,196,000 pounds in 1913.

California will show a decrease of several million pounds from the production of 32,492,000 pounds in 1913.

The production from Alaska will show but slight decrease from the 23,423,000 pounds produced in 1913. The output for 1914 is estimated at 20,850,000 pounds.

The production from Tennessee decreased somewhat from 19,489,000 pounds produced in 1913.

The lumen hour is a term which involves the unit lumen and time. A 16 candle-power oval carbon lamp has a mean spherical candle-power of 13.2 or $13.2 \times 12.57 = 165.9 \times 12 = 1992$ lumen hours.

Clubs are buildings of a semi-private character, and should be treated much the same as private houses, except that there should be a sufficient number of lights to secure when desired, an effect of brilliancy.

Concerning the Electrical Trade

News of Activity by Jobbers, Dealers, Contractors, Central Stations and Manufacturers.

Mr. T. W. Moore, District Supply Manager General Electric Company, Atlanta, Ga.,

The subject of this sketch is among the old guard in the electrical supply business of the South. Mr. T. W. Moore started in the electric business in 1900 as a member of the southern sales organization of the General Electric Company, has been a member of this organization ever since, and is now District Supply Manager of the Atlanta office.

Mr. Moore was born at Atlanta, Sept. 16th, thirty-six years ago. He attended Emory College at Oxford, Ga., and graduated in 1900. In the fall of this year he secured employment in the clerical department of the Atlanta office of the General Electric, which was then housed in a few rooms of the Equitable Building. After two years of this work he was transferred to New Orleans and was connected with that office for three years. During 1905 he returned to Atlanta to become Assistant Supply Manager, which position he held until April, 1912, when he was appointed Manager of the Supply Department.

TOM MOORE, THE JOBBERS' FRIEND OF THE SOUTH.

During this time the Atlanta headquarters of the General Electric Company have been moved twice, expanding each time until now some twenty-five offices are occupied with branches established in New Orleans, La., Birmingham, Ala and Jacksonville, Fla., and about one hundred employes are on its southern roll. The Supply Department is now larger in point of number of office members than the whole Southern sales organization of the General Electric Company in 1900, which is a fair indication of the increase in the volume of business handled now as compared to that of fifteen years ago.

In building up this business Mr. Moore has had an opportunity to study the stages of evolution through which it has passed and had a hand in shaping the policy that now seems to work out to the best advantage of all concerned. This policy as far as certain lines of the electrical supply business is concerned has as its basis the belief that the proper route for an order to take is from consumer to dealer, dealer to jobber and from jobber to manufacturer, with the representatives of the manufacturer who covers the territory of any jobber or dealer acting in the role of general promoter or advance agent for the jobber. The Company's plan is to appoint as distributors those jobbers who are advantageously located to supply a territory and at the same time in a position to handle, stock and push complete lines of supply material that can be handled through them.

In the district covered by the Atlanta office which includes the states of Louisiana, Mississippi, Alabama, Florida, Georgia and South Carolina, the following are distributors of the General Electric Company's jobbing lines:

Carter Electric Company, Atlanta, Ga.
Matthews Electric Supply Co., Birmingham, Ala.
Woodward-Wight & Company, New Orleans, La.
Florida Electric Company, Jacksonville, Fla.
Perry-Mann Electric Co., Columbia, S. C.

The following is a list of the material that is handled by these distributors:

Wiring Devices.
Fan Motors.
Code Wires & Cables.
Electric Heating Devices.
Incandescent Lamps.
Miscellaneous Supplies.

Mr. Moore is a member of the Capital City Club of Atlanta, a member of the Chi Phi fraternity, a Mason and an Elk. He is particularly interested in the development of the jobbing business of his company and a considerable part of his time is devoted to this work. He is a familiar figure at the various meetings of contractors, dealers and jobbers and always saluted as "Tom Moore, the Jobbers' Friend." There is probably no other man in the electrical supply business of the South who is better known than "Tom" Moore, an acquaintance which he has gained by his genial nature and ability to remember the name of those he meets.

Does Campaigning Pay?

Under the above heading, Mr. W. B. Ellis, Jr., of the Southern Public Utilities Company, Anderson, S. C., has the following to say in the company magazine, concerning a recent house wiring campaign conducted for twelve days and resulting in something over 300 contracts:

"When we announced to the wiring contractors our intentions along this line, some of them promptly stated that they feared such a thing would cause dull times in the wiring business for months to come. However, such was not the case. Our records of new "cut-ins" for the months following the campaign show an increase of forty per cent in new customers for the year, after deducting the three hundred campaign customers. At the present time, we are making new connections at the rate of forty per month,

as compared with twenty-eight for this period last year, and notwithstanding the fact of the general business depression. Judging from these figures, we feel that the campaign was a success, not in the number of contracts secured alone, but from an advertising standpoint as well—the interest aroused for electricity in the home having manifested itself since the campaign in increased business for the Company and the contractor.

"Immediately after the 'house wiring' campaign, we concentrated our efforts on improving store lighting by means of the new type 'C' tungsten lamps, which resulted in sixty-one installations, totaling 319 lamps of the following sizes: Three 1000-watt lamps, twenty-seven 750-watt, ninety-six 500-watt, seven 400-watt, twenty 300-watt, twenty-three 200-watt, one hundred and nine 100-watt, and thirty-four 250-watt lamps; and this was done in the face of strong gas competition.

"After accomplishing satisfactory results with type 'C' lamps, we got busy in the electric fan game during the hot weather, and placed over three hundred on the line, fifty-three of this number being of the four-blade ceiling type, and five large ventilating outfits.

Following the fan season, we took up the improvement of show-window lighting, and secured forty new contracts, increasing the window load from eight kilowatts to twenty-two kilowatts. In addition to this, we have added to our sign load twelve new signs, aggregating fourteen kilowatts, and nine kilowatts in type 'C' lamps for outside use, thereby increasing our load on the flat rate circuit from thirty-two kilowatts to sixty-three kilowatts, or ninety-seven per cent.

"A recapitulation of new business secured for the year is as follows:

Lighting customers	791
Power customers (522 horsepower)	26
Sign customers	12
Outside Lighting customers	11
Window Lighting (flat rate)	40
Heating Appliances	696
Electric Fans	350
Type 'C' Lamps	319

Does campaigning pay? I feel sure that these results are conclusive, and that all will agree with me that it does."

The National Electric Safety Code.

The revision of the National Electric Safety Code by the Bureau of Standards has been completed. The first three parts of the code, having to do with construction and installation, are being used in a preliminary edition for discussion and criticism. Part 4, which has to do with operation, has already had a preliminary edition and is about to be reprinted in a thoroughly revised form for adoption. Valuable conferences have been held with state commissions and utility companies in the east and similar conferences in the south and as far west as the coast are to be held in the near future, after which the code will be again revised and then submitted to a formal conference to be held in Washington on July 1 and 2. At this conference will be represented public-service and industrial commissions, municipal inspectors, fire and casualty insurance interests, engineering societies, and public-utility companies.

The electrical safety code runs parallel with the National Electrical Code for fire protection which is revised every two years by the Electrical Committee of the National Fire Protective Association. It is now generally realized that the rules embodied in the latter code have exerted a powerful influence toward securing better electrical construction and reducing fire hazard. The formulation, and maintenance of a life code in such a way as to cause it to be generally adopted will likewise be a potent influence in standardizing practice and reducing accidents.

The Bureau of Standards has accomplished no easy task in presenting the safety code in preliminary form. It has taken more than a solid year of work. Parts 1, 2 and 3 are presented in 162 pages of typewritten matter single spaced with part 4 after revision in 52 additional pages. After the present draft has been revised once more, approved by the Washington Conference, and republished, it will be ready for general adoption. All interested and affected by the code are urged by the Bureau to try out the safety rules and report desirable changes for consideration during the final session at the end of the first year of its use. When the code goes through its last revision it is probable that it will be generally adopted by state commissions and cities and its recognition enforced.

Electrical Prosperity Week Nov. 29-Dec. 4.

The organization of a special staff to handle the detail work of the Electrical Prosperity Week Campaign has been completed and active work has already been begun. The week of November 29 to December 4 is the time set for the event. The campaign will be under the direction of the Society for Electrical Development, with Mr. J. M. Wakeman, general manager of the society, in charge and representing the society's board of directors and the Electrical Prosperity Week executive committee.

John T. Kelly has resigned his position as Eastern publicity manager of the Panama-Pacific Inernational Exposition, to become editor of the "Electrical Prosperity Week" campaign news bureau. He will handle the general news service, besides assisting in the co-operative work with Chambers of Commerce. Before becoming an exposition official Mr. Kelly was a political writer on the New York Evening World. He had previously served in an editorial capacity on the Buffalo Courier, St. Louis Republic and Washington Post. Under the pen name of Gilbert K. Harrison, Mr. Kelly's stories of the West and its attractions have been extensively reproduced in the magazines and Sunday pages. Corneil Ridderhof, recently resigned his position as advertising manager of the Hotpoint Electric Heating Company, to handle the advertising work for "Electrical Prosperity Week." Mr. J. A. Randolph, industrial power engineer for the New York Edison Company, and a technical writer of note, is to prepare the trade press articles on the industrial power applications of electricity.

Besides the foregoing men, the campaign executive committee will have the assistance of advisory committees comprising the best known commercial men in the industry, who will serve without compensation. In addition to the special staff engaged temporarily for the campaign, the Society has its regular staff assisting in promoting the big affair.

Good Bussiness in Louisville, Ky., and Among Other Byllesby Properties.

The Commercial Department of the Louisville Gas & Electric Company during the week ending May 7 secured contracts from 136 electric customers for 101 kilowatts lighting load and 55 horsepower in motors, and took orders for wiring 27 already built houses. Eighty-two housewiring permits were issued by the City of Louisville during the week. Contracts were closed during the week ending May 14 for 600 horsepower of new electric power business. An energetic campaign for the purpose of securing gas heating installations in advance of next winter was started May 16.

All Byllesby electric properties reporting for the week ending May 7 showed net connected load gains of 246 customers with 328 kilowatts lighting load and 239 horsepower in motors. New business contracted for included 1,091 customers with 594 kilowatts lighting load and 1,367 horsepower in motors. Output of the properties for the week was 7,877,136 kilowatt hours, an increase of 13.7 per cent over corresponding week of 1914.

A New Idea in Sewing Machine Motors.

BY A. I. V. WILSON.

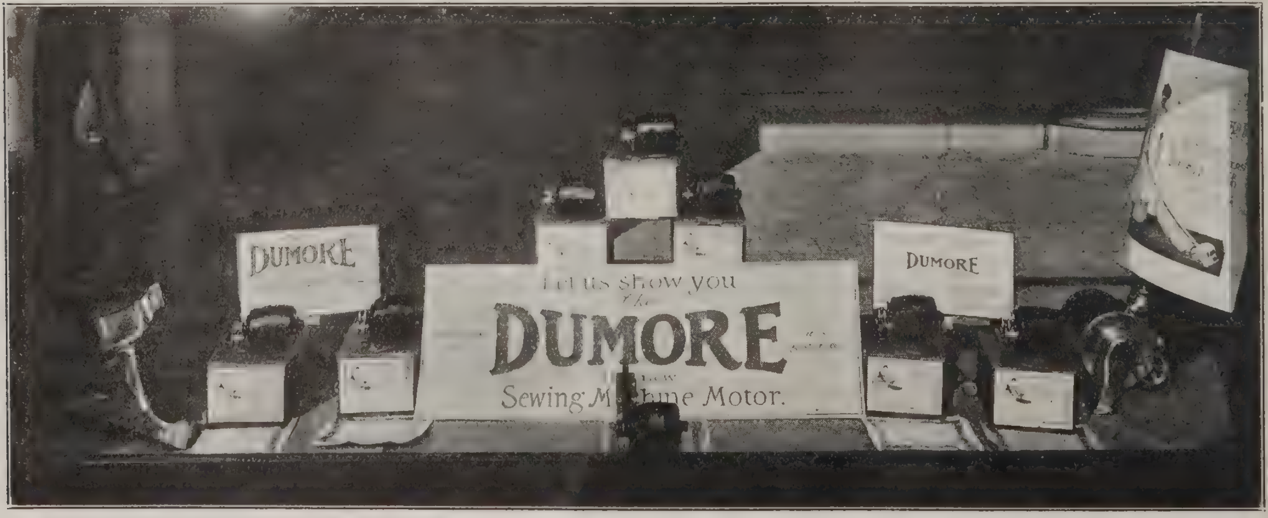
The sale of lamp socket devices for household use has been confined largely to such articles as the dealer could sell over the counter without incurring the cost of installation, such as toasters, irons, percolators, etc., that is those devices the consumer could put in use by simply connecting them to the socket. The sewing machine motor which is one of the greatest labor saving devices in a home, has had comparatively small sales. It has formerly been necessary for the dealer to send a man to install the motor on account of the screws, bolts or cumbersome clamps by which it was attached to the machine and the necessary changes and adjustment of belts. This requires a good mechanic from one to two hours and costs the dealer not less than a dollar and a half, which deducted from his profit leaves but a small margin.

To eliminate some of these objectionable features and make this field attractive to the dealer, Mr. Chester H. Beach of the Wisconsin Electric Co., Racine, Wis., has made a study of the subject and presented a sewing machine motor to the trade which seems to meet all requirements. In addition to producing a machine that can be sold over the counter the same as a lamp or a dry cell, he has also made it neat, compact and efficient at a price considerably less than is usually received for similar devices, yet allowing the dealer a liberal margin of profit. No screws, no bolts and no changes in belts are necessary to install the motor and it has an automatic cut-out that prevents unnecessary current consumption with automatic speed regulation. It is a neat, compact, self-contained little unit that simply hooks to the back of the machine and is ready for service. In addition to the other features it has a universal motor which really operates efficiently on either alternating or direct current.

When working out the design it was found that sewing machine manufacturers were violently opposed to some types of motors, as the method by which they were attached transmitted a vibration to the machine, which was greater than it was built to stand. The motor here described is attached to the machine by simply hooking it into the rear belt hole, loosening one end of the pitman rod and hooking the control chain through the treadle. Power is transmitted through the regular belt without any change whatever and the use of the regular fly wheel steadies the machine and carries it smoothly over seams and other hard places.

As no defacement or change is made in the sewing machine in attaching the motor, it may be sent out on trial, and invariably results in a sale. It is a motor that should appeal to central station companies that conduct or plan to conduct small device campaigns.

It is evident that with leading manufacturers represented at Buenos Aires it is difficult for firms without good connections in Argentina to get any important share of the trade. As already stated, difference in price and readiness to grant credit have thus far given German manufacturers a considerable advantage. As long as the war lasts Germany may experience difficulty in supplying the local market. It must be remembered, however, that the United Kingdom already does a much larger business in electrical supplies with this Republic than does the United States, and that Italy is only a short distance behind the latter country.



A Display of Dumore Sewing Machine Motors in Window of Georgia Railway & Power Co., Atlanta, Ga.

Some Special Wiring Devices

BY C. H. BROWARD.

Electric wiring can be divided roughly into two classes—concealed and exposed. Each of these classes can be again sub-divided as follows: Concealed wiring—1. Knob and tube systems. 2. Rigid conduit. 3. Flexible conduit. Exposed wiring—1. Plain open wiring. 2. Rigid conduit. 3. Flexible conduit. 4. Wood molding. 5. Metal molding. It is impossible to discuss in one article all of the devices used in connection with all of these systems and on this account these devices which present commercial difficulties in stocking and handling on the part of the jobber and dealer will be taken up as a continuation of the article in the May issue.

Reference has been made in the above mentioned article to the movement now under way to standardize plug and receptacles and when this is done another "bug-bear" will be eliminated from the contracting business. At the present time plugs are of two kinds—separable and non-separable and it is imperative that the jobber carry some of both these kinds. On account of the variety of demand some jobbers carry several types of each kind or so-called "competition" plugs and consequently have stocks that are in many cases duplicated.

In the past the Eidson base receptacles and plugs have been largely used for baseboard and special outlets. Lately, however, newer, safer and more convenient plugs and receptacles have been designed and been placed on the market. These have been favorably received and jobbers are forced to consider carrying a stock and will have to do so until some standard design of plug is adopted.

To facilitate the installation of fittings on open conduit work such as surface, and flush snap switches, rosettes, receptacles, pendant switches, sockets and the like, special

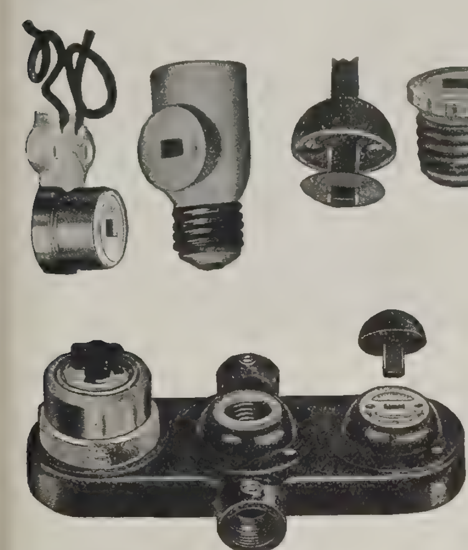


FIG. 1 HUBBELL PLUGS MADE BY HARVEY HUBBELL, INC., BRIDGEPORT, CONN.

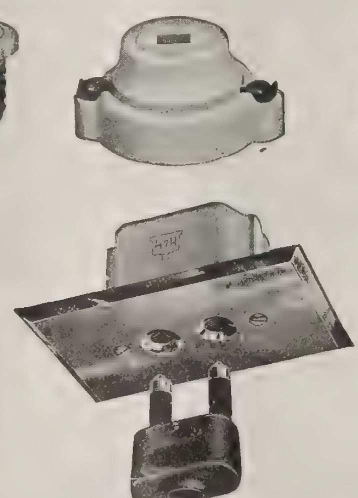


FIG. 2. RECEPTACLE MADE BY HART AND HAGEMAN, HARTFORD, CONN.

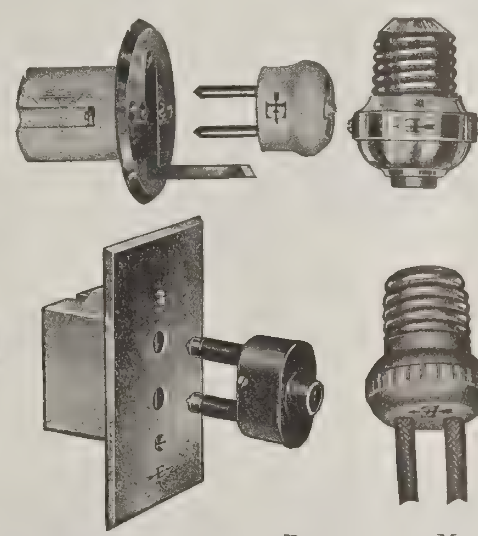


FIG. 3. PLUGS AND RECEPTACLES MADE BY ANON ELECTRIC CO., HARTFORD, CONN.

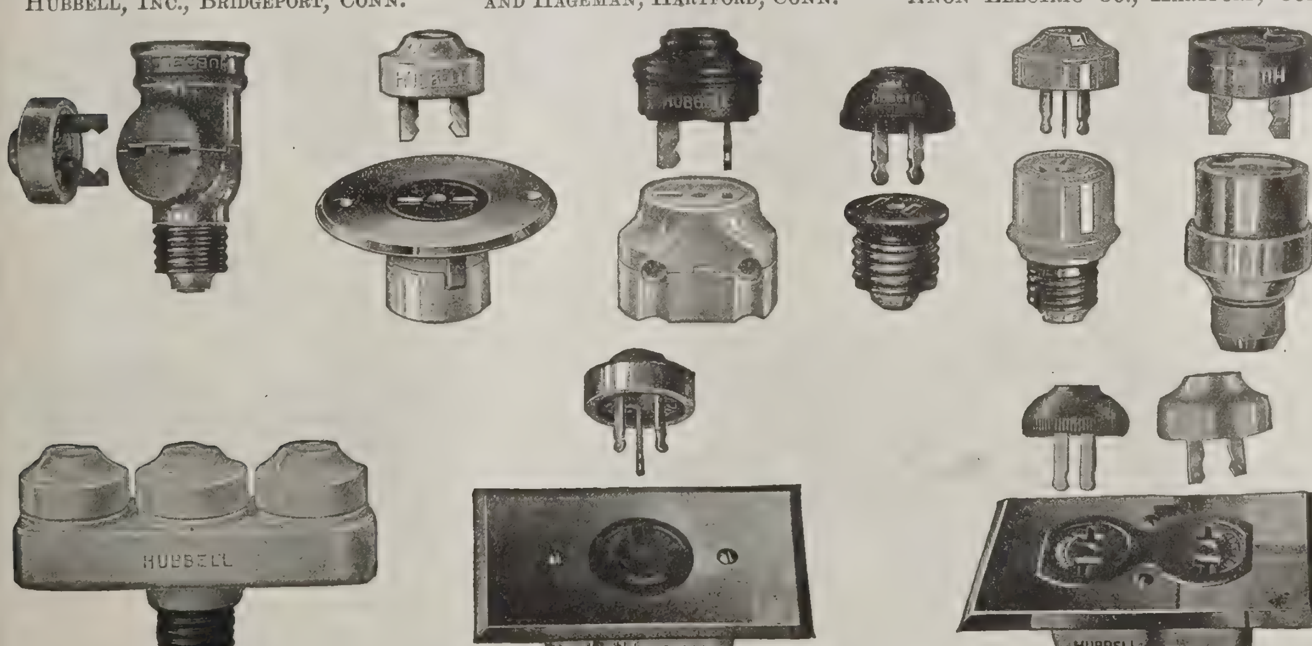


FIG. 4. PLUGS AND RECEPTACLES MADE BY HARVEY HUBBELL, INC., BRIDGEPORT, CONN.

wiring devices have been designed and are sold under such trade names as, condulets, taplets, unilets, etc. These devices not only save time for the contractor but permit a neat job. They are arranged to take standard designs of porcelain bases of the devices mentioned so that a stock of such devices can be carried that will satisfy practically all demands of the different kinds of construction with the least possible duplication, for all of the standard wiring material regularly used for cleat, concealed or molding wiring can be used when the standard pipe fittings referred to are used with conduit installations. In fact the use of these special pipe fittings effect a saving in the use of some types of devices for with "taplets" one cover fits two sizes so that for ten sizes of the "taplets" only five sizes of covers are required.

Again the use of these devices arranged in gang types save stock for the jobber and enable the wireman to economize on his job. Certain gang types of pipe fittings permit 2, 3 or 4 circuits to be run in one pipe with pro-

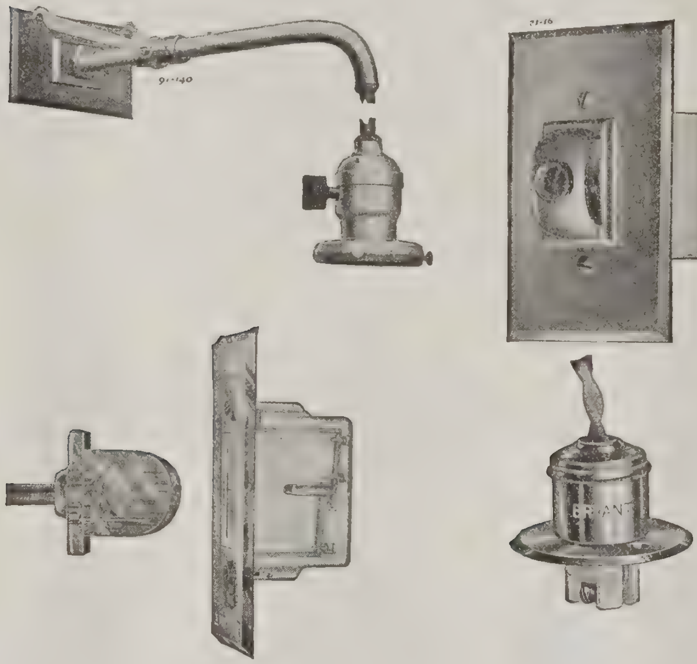


Fig. 5. Bryant Electric Company, Bridgeport, Conn.

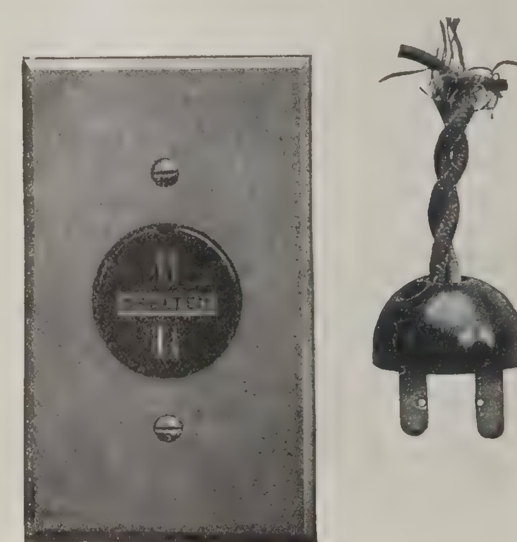


Fig. 6. Shallow Flush Composition Receptalce Chelten Electric Company, Philadelphia, Pa.

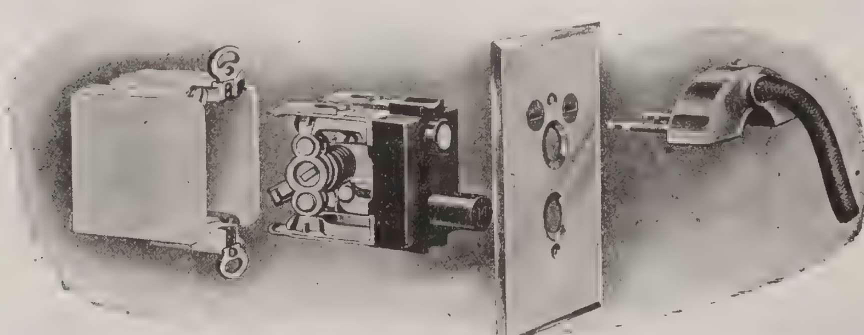


Fig. 7. Metropolitan Detachable Mechanism Combined Switch and Receptacle.

Fig. 9. Plug and Receptacle Made by General Electric Company, Schnectady, N. Y.

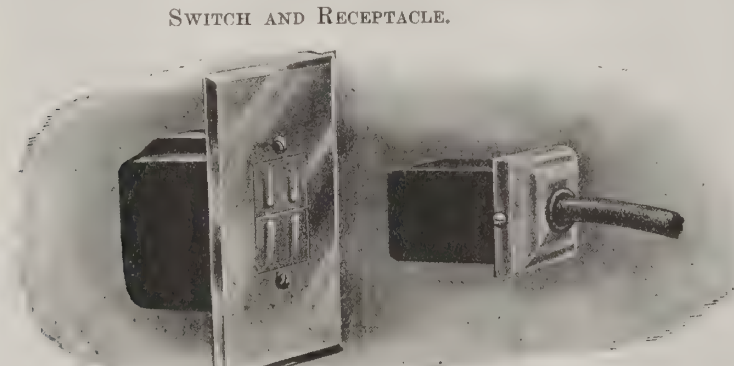


Fig. 8. Metropolitan Flush Receptacle Made by the Metropolitan Electric Mfg. Co., Long Island City, N. Y.

Fig. 10. Made by Cutler Hammer Mfg. Co., Milwaukee, Wis.

vision on one casting for the required number of controlling switches. In Fig. 2, the saving in conduit and the better appearance of the job is shown where these devices are used. The installation shown is for an 11-foot ceiling with one line of lights 5 feet from the corner and the second line 10 feet beyond. In the arrangement of Fig. 1, 24 cuttings of conduit are called for with threading and fittings while in Fig. 2 only 11 are required. The first arrangement calls for 84 feet of ½-inch pipe and fittngs costing $8.06. The second arrangement calls for 16 feet of one-inch pipe and 10 feet of ¾-inch pipe and fittings at a total cost of $5.38. There is thus a saving on this simple job of $2.68 in material used only and the problem of variety of pipe fittings to be carried by the jobber is considerably reduced. This is only one of the many ways in which manufacturers, contractors, dealers and jobbers can get together to their mutual benefit by a careful study of the best methods to use in electrical construction.

FIGS. 1 AND 2. SHOWING ECONOMY POSSIBLE IN USING SPECIAL WIRING FITTINGS AND NEATNESS OF JOB.

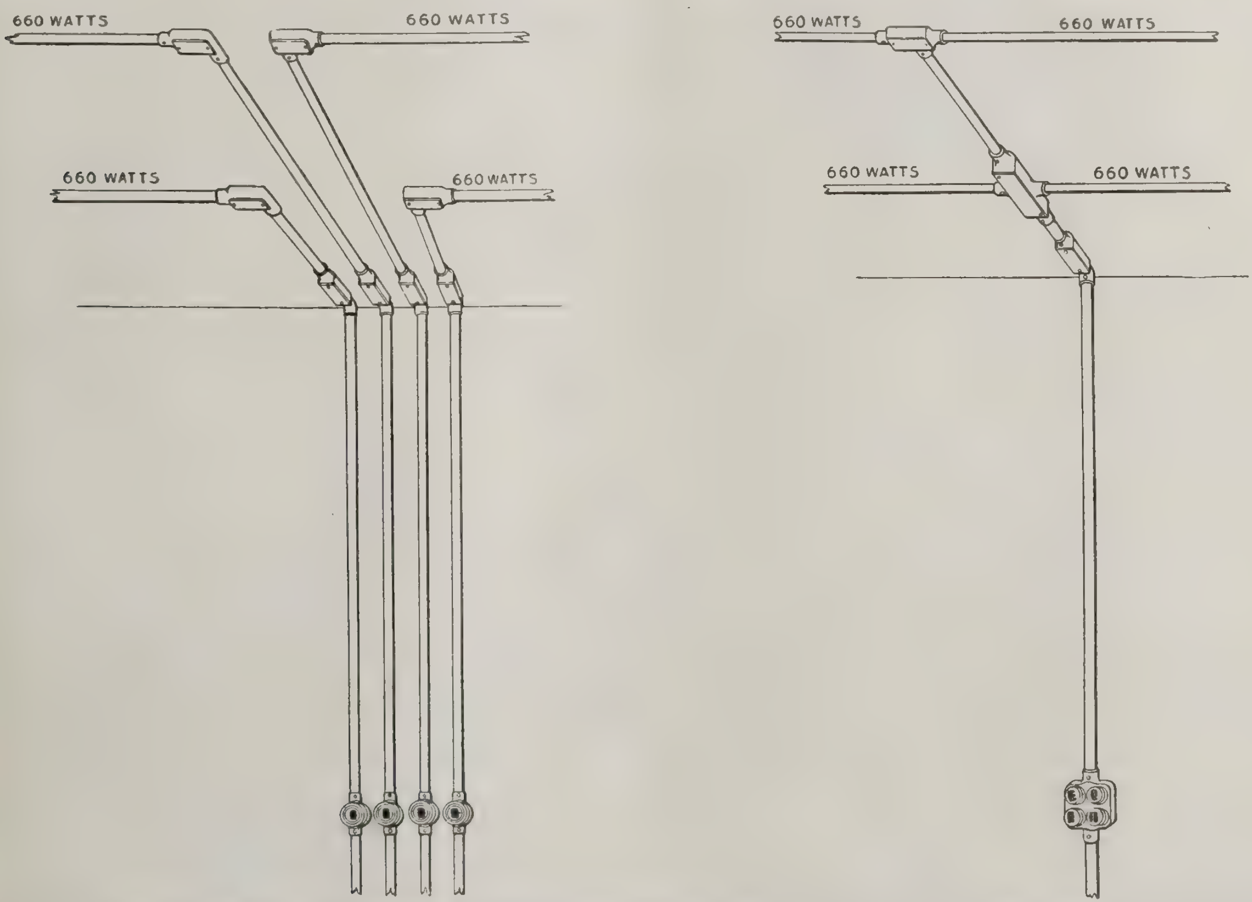


FIG. 3. PAISTE PIPE TAPLETS SHOWING POSSIBLE COMBINATIONS OF PORCELAIN AND WIRING DEVICES. HANDLED BY HART & HEGEMAN MFG. CO., HARTFORD, CONN.

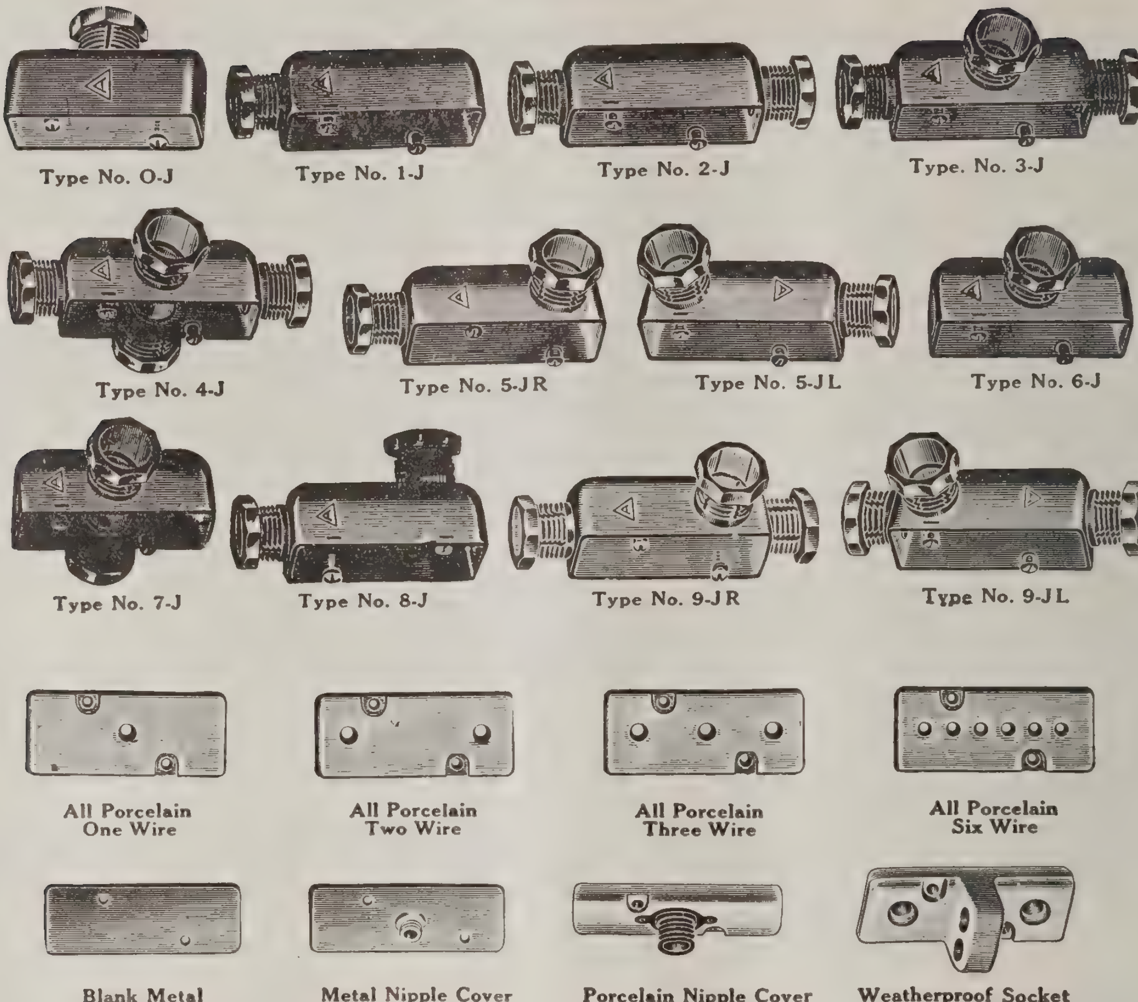


Fig. 1. Rectangular Steel Unilets and Covers Made by Appleton Electric Co., Chicago, Ill.

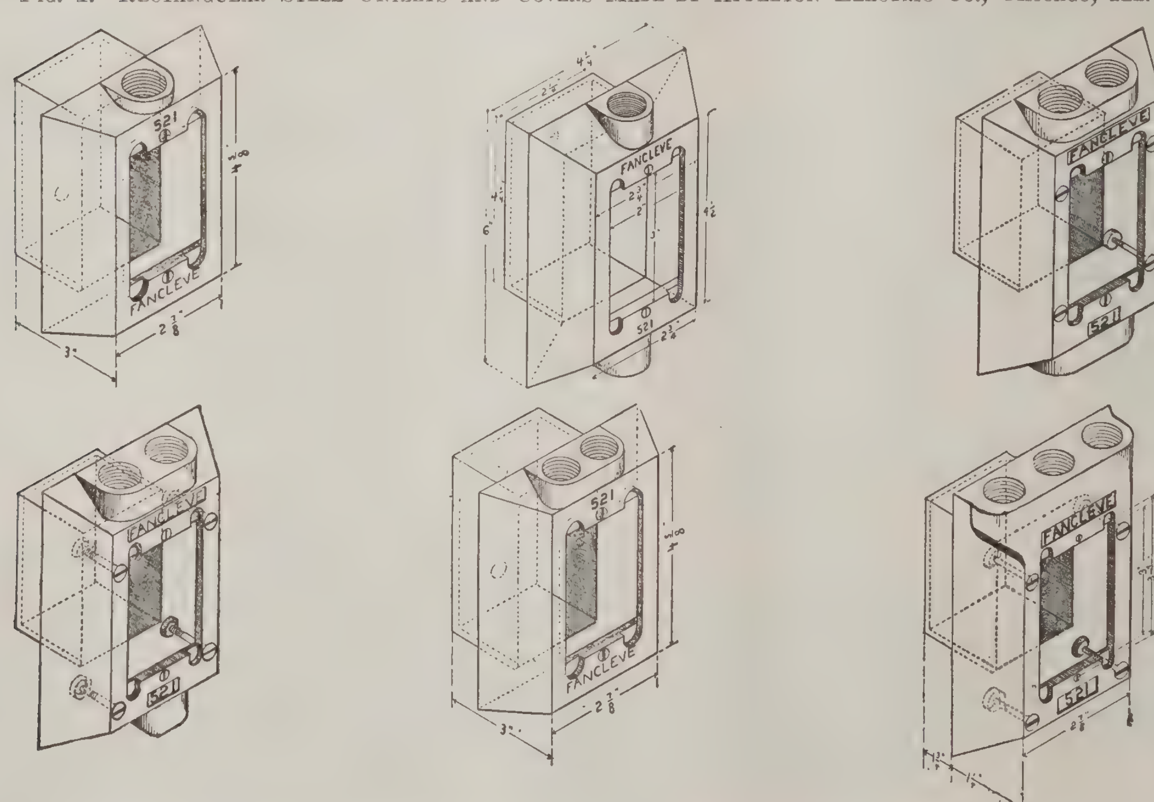


Fig. 2. Fitting for Rigid and Flexible Conduits and Armored Cable Made by Fancleve Specialty Co., Boston, Mass.

New Apparatus and Appliances

New 2500-Volt Lightning Arrester.

A single-pole lightning arrester for alternating current circuits of any frequency or capacity and for voltages up to 2,500 has been produced by the Westinghouse Electric & Mfg. Company. The arrester is weather proof and may be installed out-of-doors on poles or buildings, or indoors on station walls. It consists of a series of spark gaps between non-arcing cylinders in series with a resistor. The resistor prevents the power arc that might occur on systems

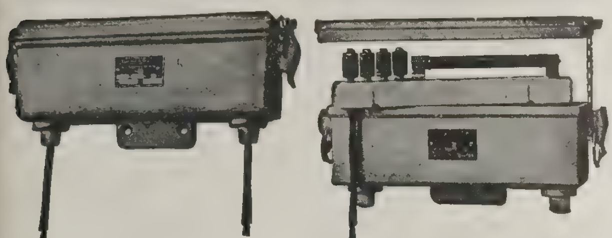


Fig. 1. A New Westinghouse Lightning Arrester.

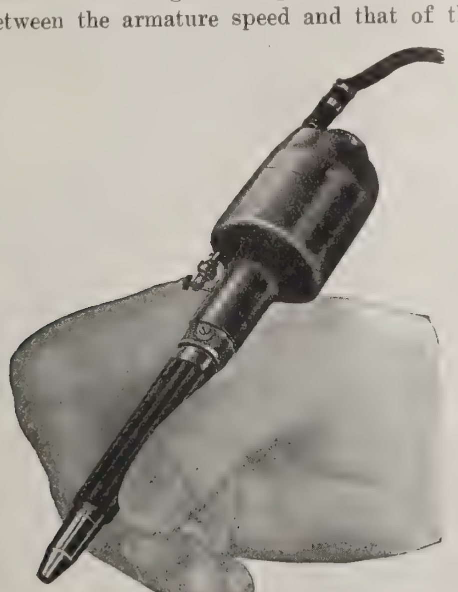
of large capacity if the spark gaps alone are used, making the arrester suitable for circuits of any capacity. The resistance is low enough to give good protection, but high enough to insure reliable operation, and to enable the non-arcing metal gaps to quench the arc to the end of the first half cycle.

The manufacturers recommend one set of this type of arrester at each distributing transformer with a minimum of five sets to the mile of line.

Small Motor for Use by Dentists.

The accompanying illustration shows a design of motor for the operation of a dental engine. It is claimed that this is the smallest motor made being 1.25 inches in diameter and 1.75 inches long, operating on 12 watts at a speed of 15,000 revolutions per minute on either direct or alternating current.

By means of an ingenious speed reduction of one-fourth between the armature speed and that of the drive



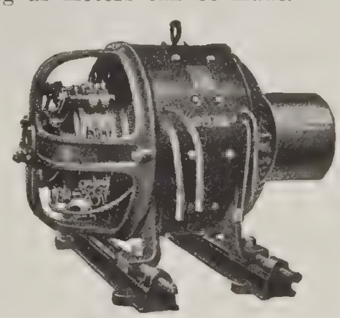
A Small Motor for Dentists.

shaft, the motor drives directly any standard dental chuck. A control switch that can be conveniently operated by the hand is mounted on the motor. It has three positions, of which the middle one is for stopping and the two extreme positions are for starting in opposite directions. Motor-speed control can be effected by means of a foot-operated floor rheostat for the regular set or by means of a compact rheostat secured to the cord for the completely portable set.

This motor has been developed and is placed on the market by the Shelton Electric Company, 30 East Forty-second Street, New York City.

A New Line of Motors.

A new and improved line of motors has recently been placed on the market by the Eck Dynamo & Motor Co., of Belleville, N. J. These machines are equipped with commutating poles, insuring sparkless commutation and have positive ventilation by internal fans. They are supplied with double row self-aligning ball bearings, which insure perfect alignment of shaft and bearings and provide greater durability and ease of maintenance than any other type of bearing besides reducing the friction losses of the motor to a minimum. These motors have no magnetic hum and are therefore as quiet running as motors can be made.



The aim of the designers has been to perfect all details so that every part of the machine would conform to the best modern standards and so that it would be rugged, durable and permanently satisfactory. Steel field frame, short shaft length, low shaft center and high efficiency at all loads are among the important features. Radial brush-holders are provided which hold the carbon brushes in correct position for either direction of rotation without the inconvenience of changing.

Chelton Enclosed Fuse.

A new design of enclosed fuse has been produced by the Chelten Electric Co., Philadelphia, Pa. This product is said to be of the highest quality, and up to the usual high standard of all "Chelten" specialties. The fuse is of uniform rating, blowing strictly in accordance with the Underwriters' requirements. At normal temperature, it will carry indefinitely 10 per cent greater load than rated capacity, and is calibrated to blow uniformly at 17½ per cent overload; this percentage being a mean between the standard limits of 10 per cent minimum and 25 per cent maximum required by the Underwriters'. A claim of extreme care in the manufacture is made to see that this accuracy is carefully preserved.

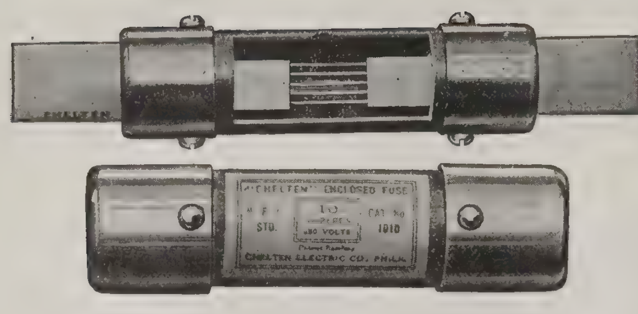


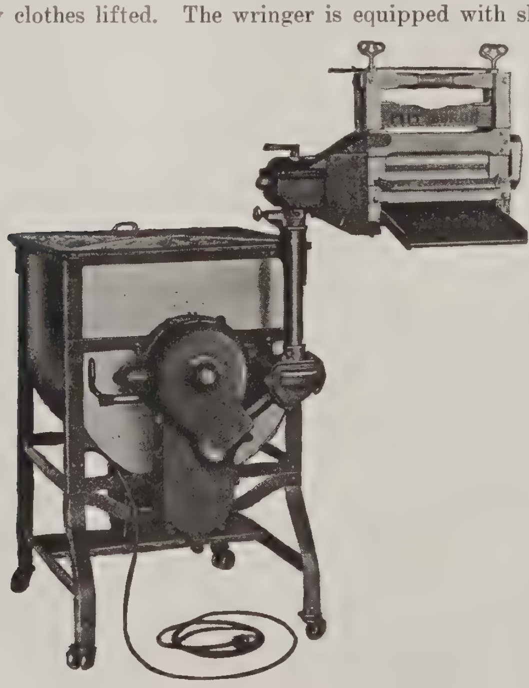
FIG. 1. SECTION OF CHELTON ENCLOSED FUSE.

The fuse strip used in this fuse is round wire drawn through a die, which is said to be more accurate than flat material which cannot be rolled as close to specifications. All fuses above thirty-five ampere have a fuse element consisting of three parts; two "lead in" strips of flat fuseable material, and the center fuse strip or strips connected to these "lead in" strips. These round center strips determine the rating of the fuse overload blow, but on a short-circuit both the center and the "lead in" strips blow, increasing the arcing distance and thus making it easier for the "filler" to extinguish the arc. These fuses are made in all standard sizes up to and including six hundred ampere, in both the 250 and 600 volt types. The Chelten Company makes "old code" fuses, as well as automobile and midget fuses.

Pittsburgh Electric Washer and Wringer.

An electric washer and wringer is now being made by the Pittsburgh Gage & Supply Co., Pittsburgh, Pa. The washer is constructed with all moving parts enclosed. It has no belts or pulleys and there is no danger of hands, fingers or clothing being caught in the mechanism. The washer is a cylinder type, arranged so that clothes are put into a perforated zinc cylinder which revolves and reverses, the hot water and suds being forced through the meshes of the clothes, and all dirt removed without rubbing or wear.

A reversing and swinging wringer is provided, of heavy construction, which can be swung around to three different positions so that the washer does not have to be moved or heavy clothes lifted. The wringer is equipped with sliding drip board, and a safety release to prevent accidents. Both wringer and washer can be operated at the same time. Two sizes of machines are made, one of eight sheets and one of 14 sheets capacity.



THE PITTSBURGH ELECTRIC WASHER.

Fargo Wiring Devices.

A number of designs of connectors have been originated by the Fargo Mfg. Co., of Poughkeepsie, New York, for making strong, low resistance joints of high conductivity. It is claimed that these connectors tend to reduce surging in a line due to bad contact at joints and reduce the resistance of line connections. The field of application is wide, as the devices are made for straight connection in splices of wire and cable, tap conections and terminal connections.

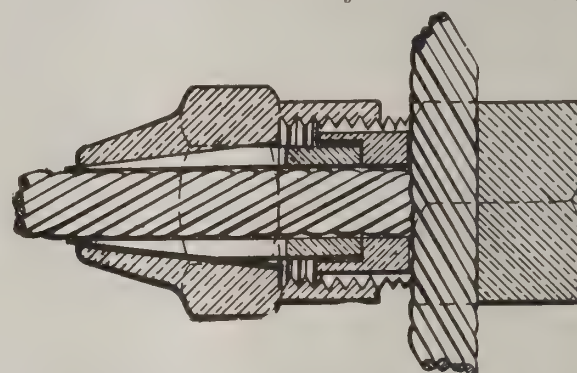


FIG. 1. FARGO TERMINAL CONNECTOR.

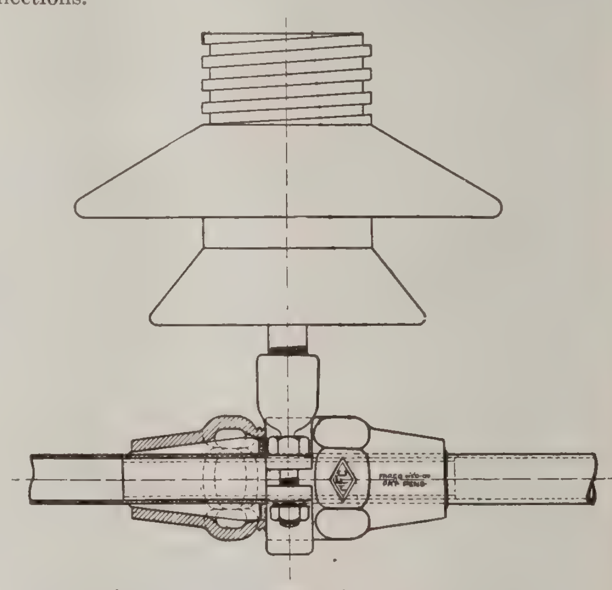


FIG. 2. FARGO BUS BAR CONNECTOR.

The illustration Fig. 1, shows the terminal connector which makes contacts without the use of bolts or set screws and most convenient for switchboard and car resistance connections. Fig. 2 shows a connection of low resistance for bus bar tubing. This connection is said to give three times the area of the tubing and holds the tubing in perfect shape.

Burke Suspension Lightning Arrester.

The lightning arrester shown in Fig. 2 is a recent design placed on the market by the Railway and Industrial Engineering Company of Pittsburgh, Pa., and known as the Burke suspension type. This arrester consists of an adjustable horn gap with resistance in series with the ground circuit. As shown in the illustration, it is not necessary to cut the line to install this arrester and no mounting is re-

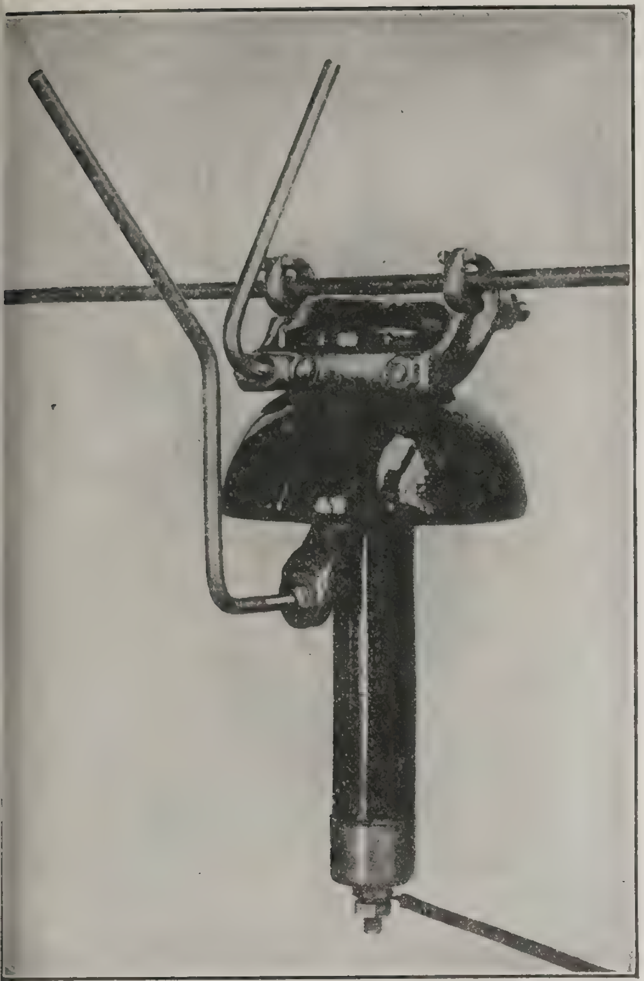
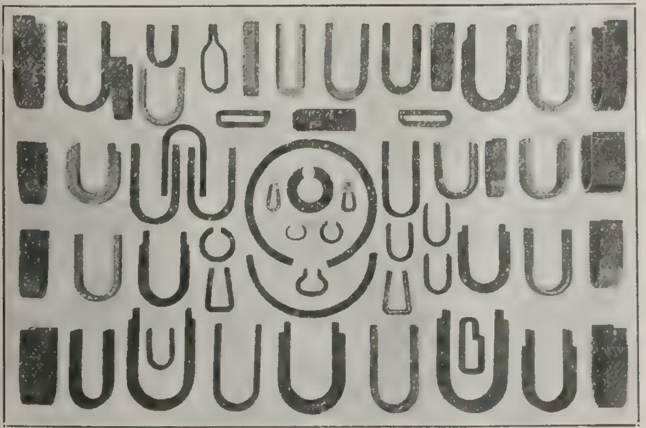


FIG. 2. BURKE SUSPENSION LIGHTNING ARRESTER.

quired. All metal parts are of brass and a new resistance material known as koppat is used in the ground circuit to limit the flow of dynamic current which might otherwise result if two or more phases discharge simultaneously. It is claimed that the arrester can be used in circuits of any capacity.

Permanent Magnets.

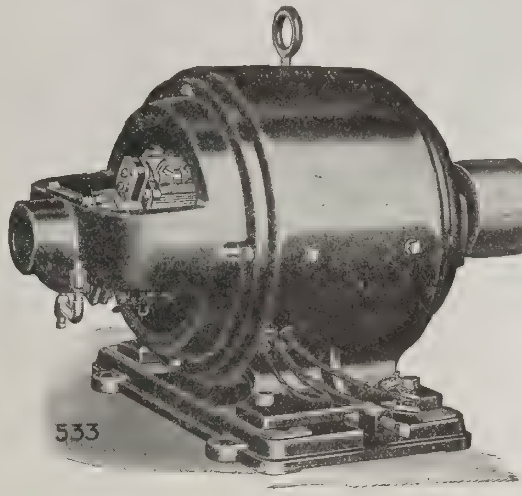
The accompanying illustration shows different designs of permanent magnets for electrical instruments and ignition magnetos manufactured by the Esterline Company, of Indianapolis, Indiana. This company has been making magnets of this sort for the past 15 years and has all necessary modern equipment for making magnets such as special furnaces for treating tungsten steel, and machines for treating the quality of magnet steel. The careful testing of raw material and the finished product, the company's claims is the secret in producing good magnets. The magnets made by the Esterline Company are being exported to England, and other European countries and supplied in large numbers to users in this country.



ESTERLINE PERMANENT MAGNETS.

New Direct Current Motor.

A new type of direct current motor has been announced by the Robbins & Myers Company, Springfield, Ohio, made in sizes from 1/8 to 3 horsepower inclusive. The frame is cast iron and of low, squatty shape, adapting the motor for installation where the space is restricted. The bearing bracelet on the commutator end extends well out from the frame and gives easy access to the commutator and brushes. The bearings are oil ring lubricated and equipped with overflow and drain plugs.



NEW ROBBINS AND MYERS D. C. MOTOR.

These motors are furnished open or fully enclosed; horizontal or vertical; for continuous or intermittent service; constant or variable speed; shunt, series or compound wound. They are made for 115, 230 and 550 volt circuits, also for service on low voltage storage battery circuits. Each motor is regularly furnished with sliding base, no-voltage release starter and cast iron crown pulley. They can also be furnished with idler pulley or back gear attachments.

Fixtures for Series Street Lighting.

The introduction of the high candlepower tungsten lamp, known to the trade as type C, has called for new designs of fixtures to accommodate this unit. In Fig. 1 and 2, designs of fixtures are shown as made by the Adams-Bagnall Electric Company of Cleveland, Ohio. These units are known as combination "abolites" and pendant "abolites."

Combination "abolites" are so designated because they are made up of different combinations of standard parts. A standard high voltage porcelain insulator carrying a film cutout socket is used in combination with different reflectors and suspension castings. This is said to be a desirable feature in point of view of the user, because should it at any time become desirable to change the candle power of the lamp or method of suspension, this can be done by interchanging the parts, making a new combination suitable for the new size of lamp or method of suspension.

In the street hoods the features of complete enclosure and proper ventilation have been well taken care of and

attention is directed to the fact that cool air is free to flow upward over the lamp bulb and through the porcelain insulator, coming out under the cast iron canopy at the top of the hood. The reflector furnishes a complete enclosure for the lamp bulb and at the same time increases the extensive light flux. Combination "abolites" are designed for straight series burning lamps. They can be furnished with reflectors only or with reflectors and double prismatic refractors.

Fig. 1. The Combination Abolite.
Fig. 2. The Pendant Abolite.

Pendant "abolites" are designed especially for use with the new high efficiency lamps of 400, 600 and 1,000 candle power. For this service they are equipped with a compensator for taking current from a 6.6 or 7.5 ampere line and boosting the current to 15 or 20 amperes as required by the lamp. Three compensators are made for use respectively with the 400, 600 and 1,000 candle power lamps.

Subway Type Oil Fuse Cutouts for High Tension Work.

A primary oil fuse cutout for subway service has been designed by the D & W Fuse Company of Providence, R. I. In the essential principles these cutouts are identical with its regular pole type. The principal changes have been the substitution of a lead gasket for the compressible gasket employed in the pole type cutout, different provision for venting the cutout and protecting it against the possibility of water entering through the vent openings, and a new method of arranging for connection with the cables in the two and three pole types. These cutouts are made in 50, 100 and 200 ampere capacities, single pole, and in 50 and 100 ampere capacities, double and triple pole, 2,500 volts.

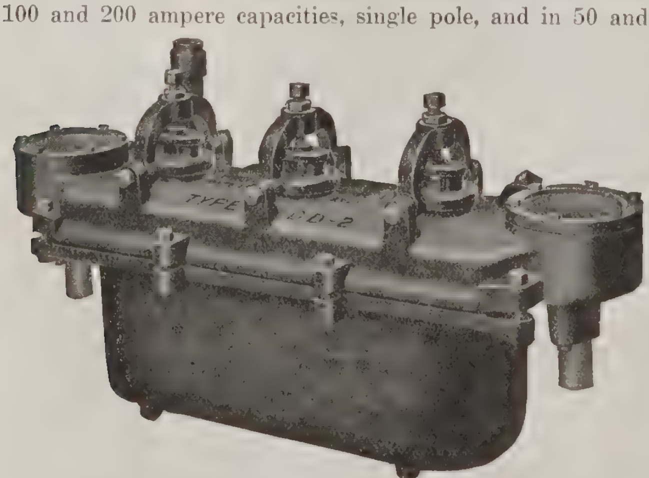


Fig. 1. Three-pole Subway Oil Fuse Cutout.

In the venting arrangement modified for subway service, provision is made for connecting the cutouts to a common venting pipe. This pipe, preferably, is carried to the highest point within the manhole and from that dropped to within five or six inches of the floor. The lower end is enlarged a few inches to the size of a pipe at least twice the diameter of the original. Should water flood the manhole, the air is compressed in the cutout as it rises and prevents the admission of any water, even should the manhole be completely filled. At the same time, any undue pressure within the cutout itself, resulting from the blowing of a fuse, is promptly relieved as the pipe would only be sealed by the water at its lower end.

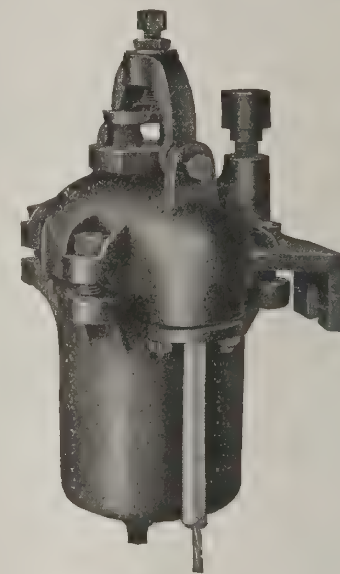


Fig. 2. Single-pole Subway Oil Fuse Cutout.

The two and three pole cutouts are equipped with a cable connection compartment at each end for the use of two or three wire cable. In making connection with the cable in the manhole the individual conductors are each equipped with a special terminal supplied with these cutouts. The cable is then passed through a bronze bushing and permanently secured in position by means of a wiped joint to this bushing. Connection is made with the several conductors within the cutout by a clamping screw, the individual conductors being separated by an insulating partition.

Portable Current Testing Outfit.

A portable current testing outfit that combines accuracy and lightness at low first cost, with a capacity of 75 to 250 amperes is now offered by the Westinghouse Electric & Mfg. Company. The transformer is so constructed that it can be clamped around any cable or feeder without opening the

Westinghohse Portable Testing Outfit.

circuit, and therefore has a wide field of usefulness in testing cables in the power house, in manholes or on the lines.

The standard outfit consists of a portable split-type current transformer, a portable ammeter, a set of leads 10 feet long and a leather carrying strap. The total weight of the outfit is less than 30 pounds. The split-type current transformer is made with a clamp at one end and a hinged

joint at the other so that the two halves can be opened up, slipped over the cable, and clamped together tightly. The use of this transformer obviates the necessity of opening the main circuit to make a test. By means of binding posts on the transformer, connections can be made for obtaining full scale readings of either 125 or 250 amperes.

Burke Horn Gap Lightning Arrester.

The accompanying illustration shows a design of horn gap lightning arrester, choke coil and fuse with resistance in the ground circuit, made by Railway and Industrial Engineering Co., Greensburg, Pa. The resistance in the ground limits any flow of dynamic current which might otherwise be experienced if two or more phases discharge simultaneously. The triangular choke coil as used with the arrester is said to not only allow the gap to ground to be set 50 per cent greater than the ordinary shunted horn gap but acts as a magnetic blowout, hastening the travel of the arc up the horns.

In Fig. 2, an outdoor substation is shown with the horn gap arresters installed. This substation is designed by the Railway and Industrial Engineering Co., and known as model D. It is here shown equipped with a three-pole horn gap switch, lightning arrester, choke coil and fuse for 2,200 volt service.

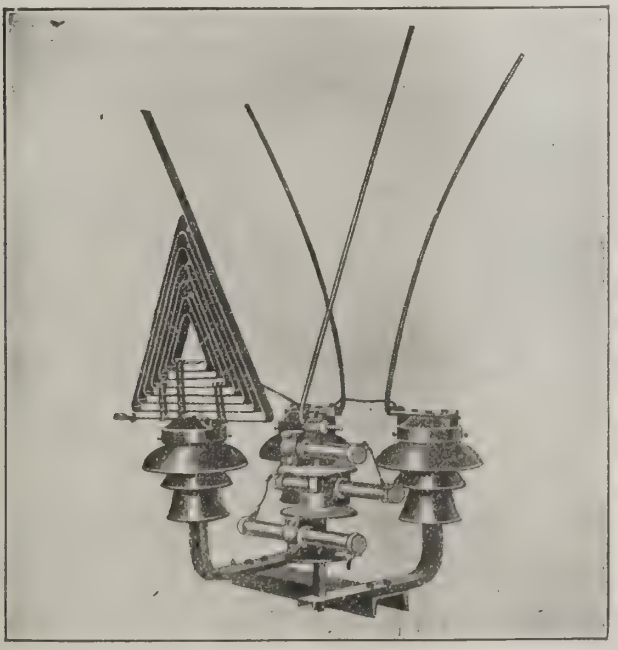


FIG. 1. THE BURKE HORN GAP LIGHTNING ARRESTER.

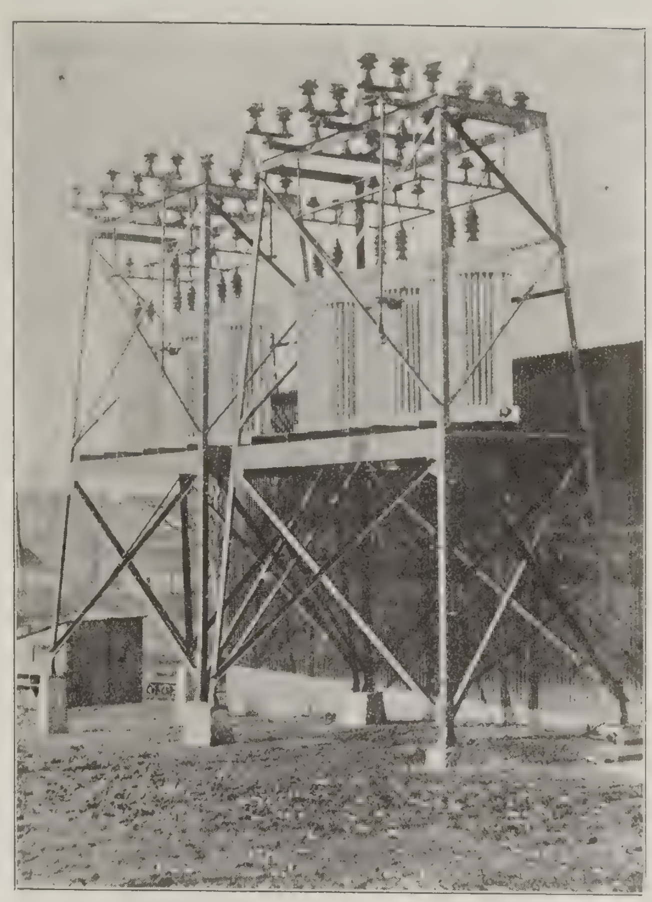
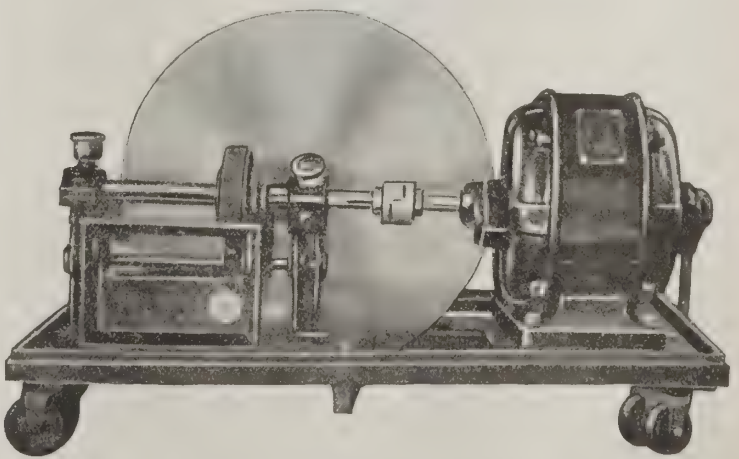


FIG. 2. SUBSTATION EQUIPPED WITH ARRESTERS IN FIG. 1.

The Peerless Motor Driven Tool.

The accompanying illustration shows a portable motor driven combination tool made by the United Mfg. Company, Kansas City, Mo. This machine consists of a revolving tool bit socket mounted on the end of a flexible shaft driven by a motor mounted on an iron base set on swivel casters. The connection between shaft and motor is through friction discs giving variable speed operation. The equipment has all the advantages of a stationary drill press and grinder. The motor can be furnished for operation on either direct or alternating current circuits.



THE PEERLESS PORTABLE MOTOR DRIVEN TOOL.

Automatic Reclosing Circuit Breakers.

A new line of circuit breakers have been placed on the market by the Automatic Reclosing Circuit Breaker Co., of Columbus, Ohio. These breakers are a new departure in the application of circuit breakers for direct current circuits since they not only open the circuit in case of overload but automatically reclose as soon as the short circuit or overload condition is removed. The overload setting

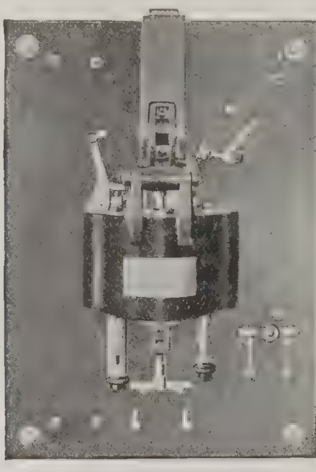


FIG. 1. THE TYPE A RECLOSING CIRCUIT BREAKER IN CLOSED POSITION.

has a range of 50 per cent below rating to 50 per cent above. An adjustment is also provided so as to permit the breaker to reclose with any desired amount of load resistance. This renders the breaker capable of distinguishing between a short circuit condition and the resistance offered by lamp or self-starting motors remaining connected on the line.

These breakers are ruggedly constructed and capable of withstanding severe operating conditions. The main contacts are of the usual laminated brush construction

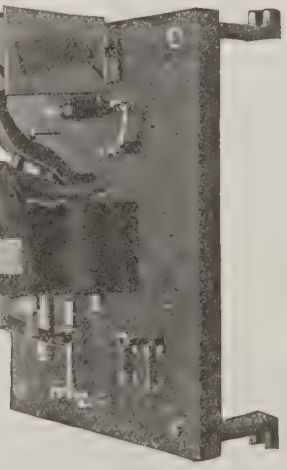
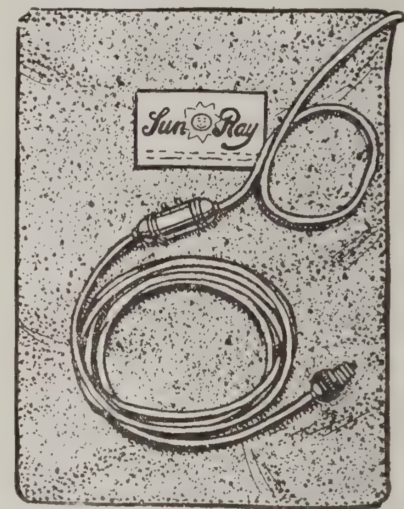


FIG. 2. THE TYPE B RECLOSING CIRCUIT BREAKER IN OPEN POSITION.

with auxiliary carbon tips for rupturing the arc. The breaker is operated by two electric magnets, and is provided with an air dash pot to regulate the time the breaker will remain open in case no short circuit exists. The breakers have been developed for the protection of direct current generators and rotary converters and also for branch circuit protection. Since they are entirely automatic and require no attendant they may be located at any convenient point in the distribution system.

The Sun Ray Heating Pad.

The accompanying illustration shows an improved type of heating pad made by the P and B Mfg. Co. of Milwaukee, Wis. In this pad the heating element is arranged so as to make the pad soft and flexible and provided with a three heat cord switch. A thermostat automatically cuts



THE SUN RAY HEATING PAD.

off the current when the high temperature point is reached and turns it on when the pad gets below this temperature. The current consumption of the pad is 18, 36 and 54 watts per hour on each of the three heats.

Electrical Construction News

This department is maintained for the benefit of contractors, dealers, manufacturers and consulting engineers.

FLORIDA AND GEORGIA.

FLORIDA CITY, FLA. The Ice, Light & Power Company of this place plans to coustruct an electric lighting system.

OCALA, FLA. The City Counsel has engaged engineers to supervise improvements to the Electric Light Plant Waterworks. The expenditure will be about $75,000. Twombly & Henney, consulting engineers, at 55 Liberty Street, New York City, have charge of the work.

WALDO, FLA. The Williams Realty Company plans to install an electric light plant sufficient to operate about 3,000 lights.

ADEL, GA. The city is planning to light one and one-half miles of the proposed Dixie Highway.

KENTUCKY AND LOUISIANA.

MOUNT OLIVET, KY. The Robertson Light & Power Co., has been organized by W. R. Bethel and R. H. Threlkeld. The company plans to do a general light and power business.

NEW ORLEANS, LA. The New Orleans Railway, Light & Power Company is planning to spend about $125,000 enlarging the power plant at Market Street.

NORTH AND SOUTH CAROLINA.

ASHEVILLE, N. C. The North Carolina Electrical Power Company plan to build a steam driven electric plant to cost about $150,000 on the French Broad River four miles from Asheville. Four thousand horsepower in generating equipment will be installed with provision for 8,000 horsepower. Westinghouse steam turbines are to be installed. S. A. Johnson is Supt. and D. M. Williams, resident engineer, with C. E. Waddell, consulting engineer.

LAURINSBURG, N. C. It is understood that the Atkin River Power Company contemplates the construction of a sub-station in Laurinsburg to furnish energy for light and power in this city, Maxton and Lumberton.

STATESVILLE, N. C.—It is understood that the Southern Power Company are planning to construct a sub-station at Statesville which will be connected to four other generating stations including the

Lookout Shoals Plant now under construction on the Catawba River. Distribution lines will be extended from this sub-station.

CHARLESTON, S. C. The Standard Elec. Co., has been incorporated with a capital stock of $10,000 by M. M. Glasser and Jacob Glasser.

WINNSBORO, S. C. This city has contracted with the Power Shoals Power Company to supply power to Winnsboro. A sub-station will be constructed and a twenty-four hour service established.

VIRGINIA.

ALEXANDRIA. The Alexandria County Lighting Company plans to install 250 horsepower boilers in its plant. F. R. Weller is consulting engineer, Hubbs Bldg., Washington, D. C.

CLIFTON FORGE. The Virginia Western Elec. Co., plan to construct a hydro electric plant with five sub-stations and 42 miles of three phase transmission line at 44,000 volts. Three generators of 600 KVA capacity each and water wheels will be purchased. A. H. Grimsby is Chief Engineer.

PERSONALS.

MR. BYRON T. BURT, who resigned as general manager of the Chattanooga and Tennessee Rivers Power Company early this year, has been elected vice-president of the Rutland Light and Power Company and will have charge of the operations of the company, with headquarters at Rutland, Vermont. The Rutland Railway, Light and Power Company is controlled by W. L. Barstow and Company of New York City. Three hydro electric plants are operated and an interurban railway power being furnished the marble and slate quarries of the section.

MR. H. R. COLLETTE, secretary of J. G. White & Company, Inc., and The J. G. White Engineering Corporation, has resigned. He expects to reside permanently in California.

J. W. SWAREN, of The Pelton Water Wheel Company, has recently delivered lantern slide lectures before the students of various engineering and industrial schools on the Pacific Coast. These lectures covered every phase of an hydraulic development, showing the most recent types of practice. In addition a number of slides were presented, showing notes of historical interest in the development of hydraulic equipment.

MR. A. B. SAURMAN, for the past twelve years Pacific coast manager for the Standard Underground Cable Company, has been appointed Southeastern manager of the company, succeeding the late Mr. T. E. Hughes, with headquarters in his native city, Philadelphia, Pa., and will return East in the early spring. He became associated with the company in Philadelphia in 1893 and after two and a half years in the construction department was transferred to the eastern sales department at New York City, leaving the position of assistant manager there in 1900, when he organized and was manager of the northeastern sales department, with headquarters at Boston, until transferred to San Francisco as manager of the company's interests there in the fall of 1902. Mr. Saurman has therefore been connected with the Standard Company for over 21 years and during the period of the greatest growth and development of this well known company. He has long been prominently identified with electrical interests upon the entire Pacific coast and has co-operated in the working out of many of the important problems of the past decade in connection with electrical distribution in that territory.

JOHN P. BELL, who will succeed A. B. Saurman as Pacific coast manager of the Standard Underground Cable Company, entered the employ of the Company at Pittsburgh, Pa., in 1896, where he has been located until transferred to the Pacific coast. For the past eight years Mr. Bell has been the assistant secretary and treasurer of the company. Mr. R. M. Hirst and Mr. Edward Kershner will continue to be associated with Mr. Saurman as formerly with the late Mr. Hughes, in the Philadelphia Office territory, with headquarters at Philadelphia. Mr. S. S. Warner in like manner remaining unchanged at the Atlanta sub-office.

Mr. Wm. P. Cochran, formerly head of the industrial and power department of the Baltimore Office of the Westinghouse Electric & Mfg. Company, has been appointed branch manager of the Baltimore Office, which has been consolidated with the Philadelphia Office of the company. Mr. H. H. Seabrook, formerly manager of the Baltimore Office, is now manager of the consolidated territory with headquarters at Philadelphia.

Mr. Cochran graduated from Pennsylvania State College in 1898 with degree of Bachelor of Science in Electrical Engineering. Upon leaving college he was appointed electrical assistant to the President of the Martic Water & Power Company at Wrightsville, Pa., which company later developed into the Pennsylvania Water & Power Company, and is now supplying electrical energy to the cities of Baltimore, Md., and Lancaster, Penn., which position he retained until 1899. He then entered the Testing Department of the General Electric Company in New York, where he was employed during the years of 1899 and 1900. In 1901 he entered the employ of the Webster Coal & Coke Company where he was electrical engineer. From 1902 to 1904 Mr. Cochran was mechanical and electrical engineer, and assistant general superintendent of the Lackawanna Coal and Coke Company, succeeding from this position to that of master mechanic for the Pittsburg-Buffalo Coal Company at Cannonsburg, Pa., in 1905.

In the fall of this year Mr. Cochran entered the employ of the Westinghouse Electric & Mfg. Company, being located at Charleston, W. Va., where he remained until the fall of 1910, at which time he left the company and became general manager and treasurer of the Kanawha Fire Engine Co., of the same city. After two years he returned to the employ of the Westinghouse Company and was assigned to the Baltimore office as manager of the Industrial & Power Division, which position he retained until his appointment identifed with the industrial and power applications, particularly that of the coal mining industry, and has a large circle of acquaintances in the electrical profession who will be glad to learn of his promotion.

INDUSTRIAL ITEMS.

THE BELL ELECTRIC MOTOR CO., Garwood, N. J., recently opened a new office in the Monadnock Building, Chicago, Ill., where a complete line of single and poly phase motors will be carried in stock. Mr. Herman Dreyer will be in charge of this office.

THE MITCHELL VANCE COMPANY on May 1st, 1915 became a part of Johns-Manville Lighting Service. Under this arrangement, the former company will devote its entire effort to the development, design and manufacture of lighting equipment, while the marketing of this product will be solely in the hands of the H. W. Johns-Manville Company.

The real significance of this arrangement reaches further in the combined efforts of these two companies for it establishes under one guidance three divisions of lighting effort. For highly specialized and localized illumination the well known Frink and J-M Linolite systems of lighting. In aesthetic and commercial lighting the Mitchell Vance product which for fifty years has figured in the lighting of America's representative buildings. Linked with this the professional cooperation and installation service of the Johns-Manville Company through its lighting specialists and construction departments throughout the United States and Canada.

THE ADAMS-BAGNALL ELECTRIC CO., Cleveland, Ohio, announces the opening of a St. Louis Branch Office, 1434-35 Syndicate Building, St. Louis, Mo., May 15th. This office will be in charge of Mr. H. E. Merrithew.

THE ASHTON MFG. CO., of Newark, N. J., makers of the "Red-Hot" line of torches and fire pots, has recently placed on the market two new kerosene torches. The tanks are made of heavy seamless drawn brass with heavy bottom and fitted with large automatic brass pump. The filler cap is fitted with air releasing screw to reduce the pressure and extinguish the flame. The burner which is specially selected from the best materials, produces a blue flame of intense heat and will operate satisfactory inside or out doors in wind and stormy weather.

THE LAGONDA MANUFACTURING CO., of Springfield, Ohio, have just published a booklet entitled, "Lagonda Boiler Room Specialties" This booklet describes and illustrates several types of boiler tube cleaners with latest improvements and boiler quick repair tools. It also covers their automatic cut-off valve and multiple strainers. Copy may be had on request.

MR. GEORGE W. HILL has joined the staff of the Society for Electrical Development. He will devote his time to the work of field co-operative section under Mr. George B. Muldaur. Mr. Hill is a graduate electrical engineer, B S degree of Tufts College, Class 1897 and has been in the electrical field continuously since his graduation. He has been three years in the employ of the Boston Elevated Railway, six years in storage battery sales, and engineering work, including two and a half years in charge of the Canadian territory of the Canadian General Electric Co. and five years with the Westinghouse interests, part of which time he was in charge of the detail supply department in Boston and the remainder of the time with the Westinghouse Lamp Co. During this time Mr. Hill has travelled extensively through the United States and is well acquainted with the men in the electrical field, so that he comes to the Society well equipped with the necessary acquaintance and experience to undertake his duties as a field co-operator.

THE ADAMS-BAGNALL ELECTRIC CO. announces the openng of a sales office April 1st at 1430 Park Bldg., Pittsburg, Pa. This office will be in charge of Mr. M. F. Knapp, who has had six years' experience as city salesman for the General Electric Co. in Pittsburg, and has, for the past year, been connected with the National Metal Molding Co.

BOOK REVIEWS.

ELEMENTARY ELECTRICITY AND MAGNETISM. By Professors Wm. S. Franklin and Barry Macnutt of Lehigh University. Published by MacMillan Co., New York City. 174 pages. Price $1.25 net.

This is a text book for colleges and technical schools presenting a study of electricity and magnetism which the authors claim is independent of any consideration of the nature of the physical action which leads to the production of electromotive force in a voltaic cell or dynamo; independent of any consideration of the nature of the physical action constituting an electric current in a wire; independent of any consideration of the nature of the disturbance which

This work is a compilation of articles on electric car maintenance the nature of the disturbance or stress which constitutes an electric field. It is a very readable and understandable work for the beginner in electrical work.

ADVANCED THEORY OF ELECTRICITY AND MAGNETISM. By Professors Wm. S. Franklin and Barry MacNutt. Published by The MacMillan Co., New York City. Price $2.00 net.

This work is a highly theoretical one taking up the study of electricity and magnetism from the standpoint of the mathematical physicist. As a text book for college use it will probably be well received and of greatest value.

ELECTRIC CAR MAINTENANCE. By Walter Jackson. Published by McGraw-Hill Book Company, New York City. 270 pages. Price $3.00.

This work s a compilation of articles on electric car maintenance that have appeared in the Electric Railway Journal. The methods described are entirely practical and use apparatus that is usually at hand in most situations. The book should be a source of useful data to those in charge of street car repairs.

CHAIN GRATE STOKERS. Compiled by engineering department Babcock and Wilcox Co., 85 Liberty Street, New York City. 63 pages with illustrations.

This book has been compiled not as a catalogue but a text book on the practical features of automatic stokers and explains the reasons for their use where overloads, high efficiencies and smokeless combustion are conditions and essentials to economical operation. The book is similar in character to this company's publication known as Steam.

SUPERHEATERS is the title of another work issued by Babcock and Wilcox Co. that should be of interest to the mechanical engineer and operator from the same standpoints as mentioned above. Both of these works can be secured at small cost.

STEAM—ITS GENERATION AND USE. Compiled by engineering department Babcock and Wilcox Co., 85 Liberty Street, New York City. Revised and enlarged. 330 pages with many illustrations and diagrams.

Among engineers of experience in the installation and operation of steam boilers, this 35th edition of Steam needs no recommendation for most of them know it. In justice to those who have been responsible for the collection of the valuable information contained in past editions and the benefit of young engineers, we desire to say however that the 35th edition is one of the most practical and useful works now publibshed regardless of the cost of same. No engineer should be without a copy of this book as it can be secured from the above company at small cost.

TELEGRAPH ENGINEERING. By Erich Hansmann. Published by DVan Nostrand Co., 25 Park Place, New York City. 395 pages with 192 illustrations. Price $3.00.

While this work is intended as a text book for students in college work, it contains much information written in a practical way of interest to all engaged in telegraph work. Simplex, duplex, quadruplex, automatic and printing systems of telegraphy are taken up as well as telegraph office equipment and details of lines, etc. A chapter is also devoted to submarine telegraphy. Some parts of the work contain mathematical discussions however the solution of practical problems at the end of each chapter help to understand the principles presented.

PRACTICAL LESSONS IN ELECTRICITY. By Millikan-Crocker and Mills. Published by American Technical Society, Chicago, Ill. 310 pages—many illustrations and diagrams.

This book is written in a non technical way taking up the principles of the electric circuit and machines together with operating details. It will be found an interesting and valuable work for home study by practical men. The book is divided into four parts, one being devoted to elements of electricity and magnetism, another to direct current dynamos, a third to alternating current and the fourth to storage batteries and small lighting plants.

ELECTRICAL MEASUREMENTS. By Bushnell and Turnbull. Published by American Society, Chicago, Ill. 165 pages well illustrated.

This is a practical handbook on design and construction of measuring instruments, their use in measurement of current, resistance and power. It takes up methods of measurements and gives diagrams of the connections when using the different meters described. This is a practical book for practical men.

APPLIED ELECTRO-CHEMISTRY AND WELDING. By Burgess and Crovens. Published by American Technical Society, Chicago, Ill. 132 pages well illustrated.

The above work gives the essential details of the electric furnace, the manufacture of ozone and nitrogen by high tension discharge and the application of electric, gas and chemical welding to manufacturing and repair work. Types of equipment and its operation are described and explained in a way that will interest the operator.

ALTERNATING CURRENT ELECTRICITY, by W. H. Timbie and H. H. Higbie. Published by John Wiley and Sons, Inc., 432 Fourth Ave., New York City. 534 pages. 379 illustrations. Price $2.00.

In this work, which is the first volume covering a complete course on alternating current electricity and its applications, the authors have presented a thorough treatment of the general principles, everywhere closely associating the principles with the machines, the methods and the facts of everyday practice. To this end more than 750 problems have been introduced, most of which are based on actual engineering data. The text will consist of two courses, with (however, no break in continuity. The purpose of the first course is to acquaint the student with the larger facts of alternating current phenomena. The second course, ready early in 1915, explains in greater detail matters relating to the construction and characteristics of operation of common types of machines and appliances.

The book is written in language simple enough to be readily understood by beginners, and at the same time, complete enough to be a proper foundation for engineering practice or for later advanced study.

PUBLIC UTILITIES; THEIR COST NEW AND DEPRECIATION, by Hammond V. Hayes. Published by D. Van Woster and Company, 25 Park Place, N. Y. City. 275 pages. Price $2.00.

The author of this work makes the following statements in its preface: The object of the present work has been largely to bring to the minds of those, whose duty it is to ascertain the figures representative of value, three distinct issues: first, that it is the duty of the appraiser not to ascertain the fair present value, that function belongs to the court or commission, but to ascertain with accuracy such figures as are necessary evidence of value and loss of value; second, that the original cost can be obtained without inordinate difficulty and is a figure of importance to those who must rule as to what the fair present value should be; and third, that depreciation is affected only indirectly by inefficiency and that, as a necessary consequence, depreciation is dependent wholly upon the relation of the age to the life of the perishable property. It is appreciated that, as a practical matter, evidence as to possible value will be offered by experts employed by one side or the other in a controversy, and that, as a necessary consequence, such experts will be inclined to advocate figures most favorable to the interests of their employers. On the other hand, it is a fact that a long step toward the removal of the present apparent diversity of rulings will have been made when the experts' figures faithfully represent the true replacement cost, the actual original cost and the real loss in value due to depreciation.

This Issue 9,000 Copies

ELECTRICAL ENGINEERING

Vol. 47. JULY, 1915. No. 7

The Illumination of Interiors

BY PRESTON S. MILLAR, 1912-13 PRESIDENT OF ILLUMINATING ENGINEERING SOCIETY.

IN what follows an abstract is presented of a paper presented before the Illuminating Engineering Society and considered by prominent electrical engineers one of the most instructive ever given on the subject of illumination. The illustrations shown are from photographs of results secured in miniature rooms, 4 by 4 feet and 3½ feet high with lamps so operated as to produce 64 lumens in each room, thus permitting a comparison of various lighting systems on an equitable basis.

When a room is illuminated by a bare lamp (Fig. 1, right), the results are unsatisfactory for a number of reasons. In the first place, the walls receive the major amount of the light produced and the portions of the room in which the light is more likely to be utilized are inadequately illuminated. The light source is unattractive and, when within the field of vision, is annoying, if not actually injurious to the eyesight. This latter effect, included under the name of glare, is very noticeable in the illustration, where the lamp is at the center of the field of vision, and the effect is exaggerated beyond that which would be experienced by occupants of the room.

If the lamp be shielded from view (Fig. 1, left), conditions are much improved. Much of the discomfort and annoyance disappears. While the distribution of light on surfaces seen within the rooms is not changed materially, yet everything can be seen more distinctly.

One of the important functions of a reflector or other lighting auxiliary is to thus shield the lamp from view, by interposing between it and the eye, either an opaque or a translucent medium. This is accomplished in room No. 2. (Fig. 1, middle).

A reflector should, however, fulfill other equally useful purposes. In shielding the lamp from view it may also be made to direct a considerable proportion of the light where it can be utilized to best advantage. Much study has been given to this aspect of the problem, and the performance of any standard type of reflector may be ascertained by reference to photometric tests of light distribution, which practically all manufacturers of reflectors are today prepared to supply with their wares. Perhaps in no branch of illumination have such great strides been made in the past ten years as in the design of reflectors in particular, and lighting auxiliaries in general.

It has been noted that the bare lamp distributes but a small proportion of the light downward. In room No. 2 (Fig. 2), a reflector is employed which redirects downward a goodly proportion of the light, illuminating the card below it much more brightly than would a bare lamp. In room No. 3, this redirection of light is effected in such a way as to concentrate a large proportion directly below the lamp, thereby illuminating the card to a brightness which is about twice that of the card in room No. 2, which was considerably brighter than the card in the room where no reflector was used.

In room No. 1, as now equipped, a reflector is employed which has been designed without regard to optical laws, and which, though looking like a prismatic reflector, has in fact almost none of the qualities which characterize such glassware. It accomplishes little in the way of redirection of light, while affording but an ineffectual protection for the eyes against brightness of the filament. It absorbs a certain amount of light without rendering any

FIG. 1. SHOWING IMPORTANCE OF SHADING LAMPS.

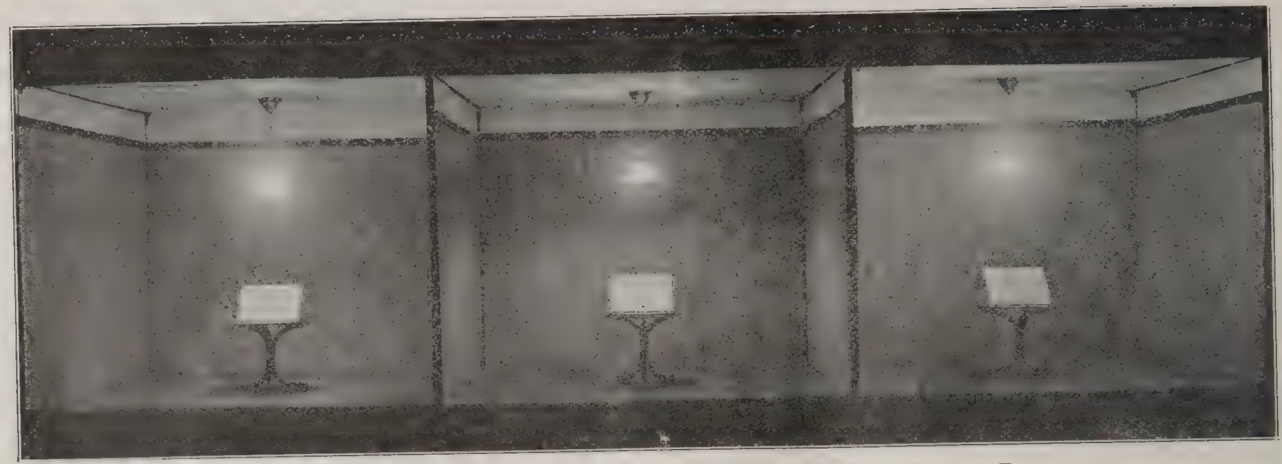


FIG. 2. SHOWING VARIETY OF LIGHT DISTRIBUTIONS OBTAINED BY REFLECTORS.

adequate return in improvement of conditions.

In the three rooms there is illustrated the range of practicable accomplishment in the employment of reflectors, if we omit opaque reflectors, which would not be suitable for employment under such conditions. In room No. 1, general distribution of the light throughout the room; in room No. 2, effective redirection of much of the light downward, largely increasing the intensity on the table plane, though illuminating the walls and ceiling brightly enough to avoid the appearance of dimness. In room No. 3, the concentration within a small area beneath the lamp is very marked, this being effected by taking from the walls and from the table plane near the walls a portion of the light which falls upon them in room No. 2, and concentrating it upon or near the table. The relative intensities of light distributed downward may be judged from the floor brightness.

The correct design of a reflector to accomplish a given purpose involves the application of well-known optical laws. With prismatic glass and mirror types of reflectors, a wide variety of distribution may be obtained. With opal or phosphate glasses, such as that in room No. 2, the possibilities of securing high concentration are rather more limited, though with this one exception these, too, may be designed to produce practically any distribution likely to be required.

In achieving the particular distribution which characterizes a given reflector, it is important that the light source be correctly located with reference to the reflector. The use of an incorrect shade holder or of an improper lamp distorts the distribution and usually detracts from the appearance and usefulness of the lighting unit.

In reflectors, as well as in globes and other forms of glass lighting auxiliaries, the degree of optical density is important, affecting both the performance and the appearance of the glass. This is an important feature to be considered in selecting glassware. In the now rather common forms of display street lighting, which utilize clusters of tungsten lamps in globes, very displeasing effects are sometimes encountered, due, first, to the non-uniformity of the globes, and second, to the insufficient density which makes the location of the lamp apparent, instead of rendering the whole surface of the globe equally bright, making it

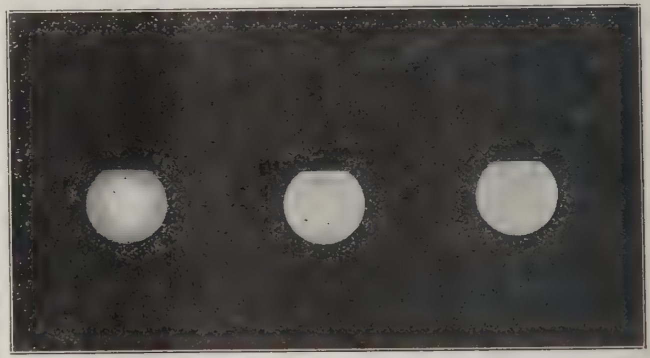


FIG. 3. IMPROVED APPEARANCE OF GLASSWARE WHEN IT CONCEALS LAMP.

appear a ball of light. Much of the lighting glassware in use in residences a few years ago, and it is to be feared even today, consists of etched or frosted crystal glass which serves chiefly to give the fixture a somewhat finished appearance. It neither directs sufficient light usefully to make it efficient nor conceals the light source sufficiently to

FIG. 4. APPEARANCE WITH VARIOUS WALL DECORATIONS.

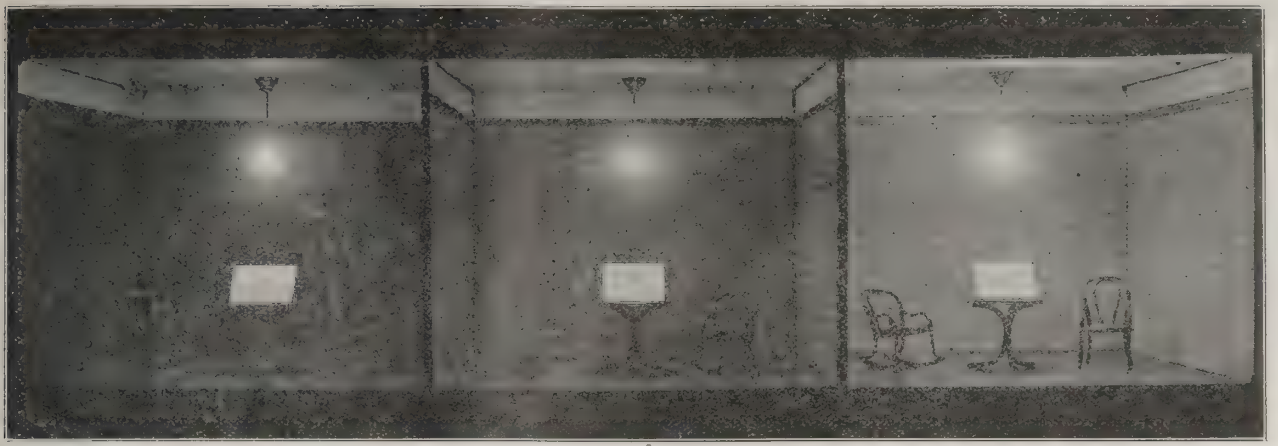


Fig. 5. Effect Produced by Reflectors which Direc t Light Downward.

make it attractive or of value in protecting the eyes.

In Fig. 3 there is a globe of crystal glass, roughed inside; a light opal globe and a denser opal globe. The last presents a better appearance without involving serious sacrifices otherwise. The light absorptions of these balls are respectively:

Frosted ball	6%
Light opal ball	13%
Dense opal ball	22%

When employed in the miniature rooms shown in Fig. 2, the relative light intensities throughout the table plane averaged:

Frosted ball	100%
Light opal ball	106%
Dense opal ball	95%

In the class of lighting auxiliaries in which decorative effect is the chief object, a wide variety is available, and much of it is pleasing and tasteful. Unfortunately, however, such auxiliaries are characterized by inefficiency to an extent which appears rather unnecessary. It is probable that in the developments of the next few years we shall note a strong tendency to improve the efficiency of some types of decorative reflectors without interfering with their decorative qualities.

The influence of room decoration upon the amount of light required to illuminate a room properly is very marked; or, stated otherwise, with a given amount of light produced in a room, the effectiveness of the illumination is largely influenced by the character of the decorations. Considering the simple case of a bare lamp, employed to illuminate rooms having light, medium and dark walls, respectively, we may note a number of interesting effects (Fig. 4). In the first place, the illuminated card on the table in room No. 3 appears brighter than the cards in the other rooms. It must be apparent that the card cannot be brighter because it receives light from the lamp and the ceiling only, while the card in room No. 1, for example, receives light from the corresponding light sources and ceiling, which is enhanced considerably by light reflected from the walls. The card in room No. 1 is actually 30 per cent brighter than the card in room No. 3. That it does not so appear is an example of the effect of contrast, which in illumination is a very important fundamental. A corresponding comparison may be made by observing the upper part of the wall in each room, where again the white paper appears brighter in room No. 3 than in the other rooms. Though actually not so bright as the white surfaces in rooms Nos. 1 and 2, these surfaces appear brighter in room No. 3 in comparison with the dark wall paper to which the eye naturally adapts itself more or less.

In room No. 1, portions of the furniture which are but slightly illuminated, as legs of the table, stand out distinctly, being silhouetted against the light rear wall. In room No. 3 so small is the contrast between the rear wall and the dimly lighted portions of the furniture that it is difficult to discern the latter.

The glare due to the exposed light source is more serious in room No. 3, due to the larger contrast between the light source and the walls. Shadows of the furniture against the walls are very prominent by contrast in room No. 1, in spite of the fact that the shaded areas are more brightly illuminated by light which is generally diffused within the room.

The brightness of walls is an important element, affecting ocular comfort probably more seriously than the illumination of the table plane. Generalizing, it is probably the best rule to avoid extremes of wall decorations, whether they be light or dark. If the walls are of high reflecting power it is important to so direct most of the lighting that the amount permitted to fall upon the walls will not render them so excessively bright as to be trying to the eyes. The illuminating engineer cannot control wall decorations, but he can control the light produced within the room, and can so direct it as to secure the best effects.

In the next photograph a reflector which directs the light downward rather largely is shown. This detracts from the brightness of the upper portions of the walls, the change, of course, being most apparent in room No. 1, where due to the relatively high reflecting power of the wall paper, the wall was brightest in the last photograph. The lower portions of the walls are somewhat brighter than when bare

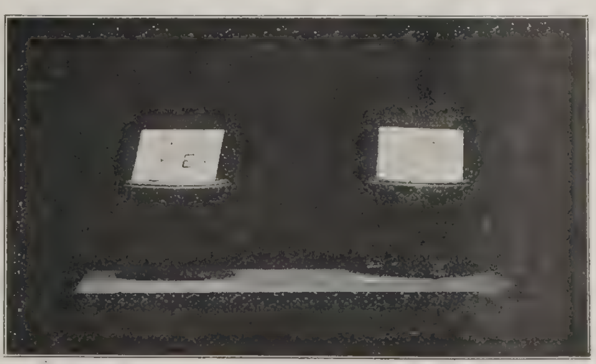


Fig. 6. Glare Due to Specular Reflection From Glossy Surface.

FIG. 7. MANNER IN WHICH TABLE LAMP IS USED.

lamps were employed. Due to the better lighting of the floor, the lower portions of the table and chairs, which with the bare lamps could hardly be seen, are now slightly illuminated. With this installation the effect of the ceiling and walls is lessened, because a smaller amount of light is permitted to fall upon them, reducing their illuminating power. That is to say, when a suitable reflector is employed, the table plane illumination intensity is more nearly independent of reflection from ceiling and walls, and instead of relying upon the latter for assistance in producing useful illumination, the problem is simplified to one of rendering the walls bright enough to produce a cheerful appearance.

It has been shown in the above that the ceiling and wall decorations, when light in tone, may be of material assistance in increasing the illumination intensity on the table plane. It may be argued as the corollary of this that when the walls are dark and incapable of augmenting the table plane illumination materially, the use of reflectors for that purpose is all the more important.

We have discussed the effective glare due to the presence of a bright light source within the field of vision. This effect would be almost, if not quite, as disturbing, if instead of having a lamp within view, an image of the lamp were to be seen in a mirror. In that event, the effect would be due, not to the presence of the light source, but to specular reflection of the light from the mirrored surface. It is perhaps unfortunate that most artificial surfaces which we are likely to view are sufficiently glossy or polished to partake in some measure of the qualities of a mirror; that is, to reflect light specularly. Some surfaces which are very mat and free from gloss diffuse the light so generally that the specular element of the reflection is immaterial for most purposes. But in most paper employed in books and magazines there is a considerable element of specular reflection, and this characteristic is responsible for much of the difficulty which demands adroit handling by the illuminating engineer in utilitarian lighting.

Referring to the demonstration cards (Fig. 6), you are asked to note that the paper and letter on the right half of each have glossy surfaces, while those on the left have diffusing surfaces, being almost totally free from specular reflection. On the right half, one may see, when in line with the direction of the reflection, a distorted image, or a number of distorted images, of the light source, much as though he were viewing the source through a very imperfect mirror. On the left it is noted only that the surface is illuminated and no trace of an image of the light source may be seen. From all positions the letter on the left half of the card may be seen. From a particular direction (right photograph) that upon the right half of the card can be seen only with great difficulty, if at all, because it is viewed from the direction in which the glare is manifested.

No small part of the dissatisfaction with illumination installations is due to this effect of glare from observed surfaces. The statement may be ventured also that no small part of trouble with eyes is traceable to the same source. There are three remedies: One is to eliminate glossy surfaces wherever possible; particularly is this important in schoolbooks, and it is very gratifying to know that serious efforts are being put forth with a view to regulating this matter. The second remedy is to reduce the brightness of light sources as much as practicable by passing the light through a diffusing medium of large area, or by reflecting it from a diffusing surface of large area in order that when specular reflection from an observed surface is encountered, the brightness of the light reflected may be so low as to minimize the difficulty. The third remedy is to so locate light sources, or so locate the illuminated surfaces and adjust the position in working or reading that the direction in which light is reflected specularly shall not be toward the eyes. All three of these possible remedies should be kept in mind and applied wherever practicable, and any one or a combination of a part of each of the three can be made effectual in reducing the trouble to a point where it is not serious. The growing appreciation of this element of

FIG. 8. ILLUMINATION FROM WALL BRACKETS ALONE.
FIG. 9. DAYLIGHT ILLUMINATION.

illuminating engineering work has been the distinguishing feature of the past two years in the illumination field.

Daylight, being that under which the human eye has been evolved, may be expected to possess the qualities for which the eye is best adapted. Neglecting other differences between the natural conditions for which the eye is adapted and the artificial conditions with which we have surrounded it (such as the change from distant to near vision and the change from use of the eye during daylight hours only to use of the eye for almost as long a period during the hours of the night), there still remain certain differences between artificial and daylight, the study of which forms a most interesting field for illuminating engineers. Daylight out of doors is the standard against which we must compare both artificial light and daylight indoors, for the daylight which is available in our interiors differs materially from that out of doors in respect to quality, intensity and direction. The intensities may be from 0.01 to 0.001 of those which prevail out of doors in bright sunlight. The quality may differ not only in respects which are not perceptible to the eye, but often differs in colors due to the influence of the absorption of colored walls, etc., which materially alter the color of the natural light. The direc-

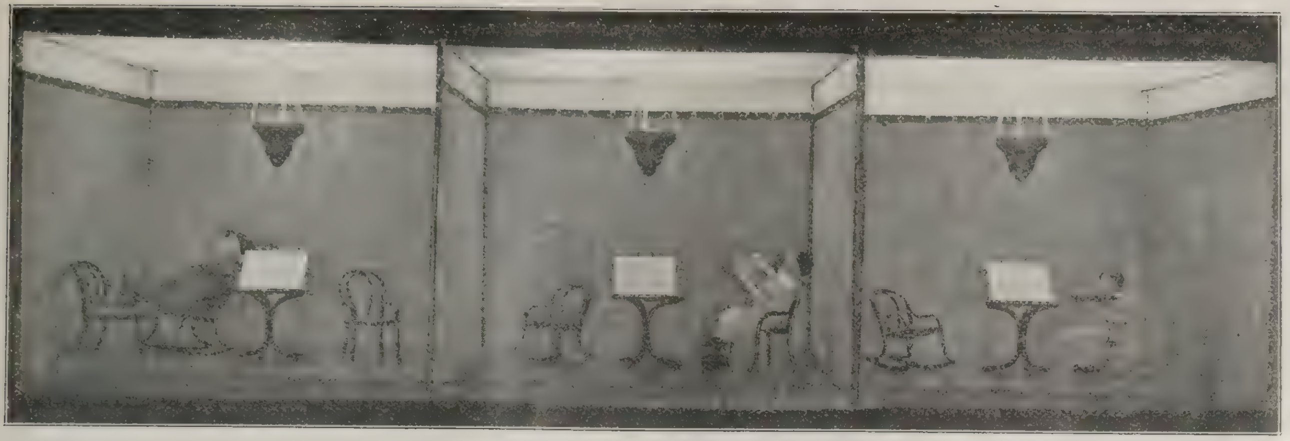


Fig. 10. Application of Indirect Lighting.

tion is usually quite different. In regard to the desirability of such direction of light as that which is prevalent in interiors illuminated by daylight, there is considerable discussion at the present time, pro and con. The writer's view is that usually the direction is undesirable. The usual direction of the light is in my opinion objectionable both from the standpoint of utility and good appearance of the room. The proper utilization of daylight for interior illumination is a subject of which the study has not yet been undertaken seriously.

There is one quality, however, in daylight, whether out of doors or indoors, which has until recently been lacking in our artificial lighting—and that is ample diffusion. Interiors are illuminated as a rule from a portion of the sky, the light source being as large as the unobstructed portion of the window. Out of doors, even in brilliant sunlight, the skylight is a considerable factor in the total illumination. Of recent years more attention has been given to this quality of diffusion, which previously had been lacking in our artificial lighting. Early consideration of lighting principles brought realization of the harm which exposed light sources work, and led to attempts to conceal the light source. There was evolved among other systems, that of cove lighting. The system has not been largely applied, it being found possible to realize its advantages by other methods which are free from some of its disadvantages.

More recently another system of indirect lighting has been developed in which central fixtures are employed to conceal the lamp from view and direct much of its light to the ceiling, from which surface it is diffused downward. More engineering study has been devoted to this system of lighting, and in consequence its possibilities have been more largely realized than were the possibilities of cove lighting. This system of indirect lighting has been widely exploited, and has given considerable satisfaction in a wide variety of installations.

Direct lighting, in which the great bulk of the light utilized comes directly from the light source, had been abused with detrimental results. Particularly was it lacking in diffusion. Indirect lighting is the other extreme, possessing in a high degree the element of diffusion which is so often lacking in direct lighting systems. The rapid growth of indirect lighting is the manifestation of a protest against abuse of direct lighting. Its effect has been to introduce into direct lighting practice a considerable general improvement, which has corrected, or decreased some of the evils of direct lighting. And too much credit cannot be given to the exploiters of indirect lighting devices for the beneficial influence which they have exerted upon our lighting practice in general.

In the lighting fixtures here shown (Fig. 10), the lamp in the metal bowl is backed by an efficient mirrored reflector, which directs its light toward the ceiling. The rooms have been equipped with three ceilings—one is white, and has about as high a reflecting co-efficient as is likely to be found in practice. Another is cream-colored, and reflects a smaller proportion of the light. A third is dark cream, approaching a tan, and reflects still less of the light. This latter is about as dark as one might expect to find employed in an indirect lighting system where any attention is paid to efficiency. Indirect lighting is so largely dependent upon the reflecting qualities of the ceiling that the statistics of the illumination intensities in these rooms are of interest.

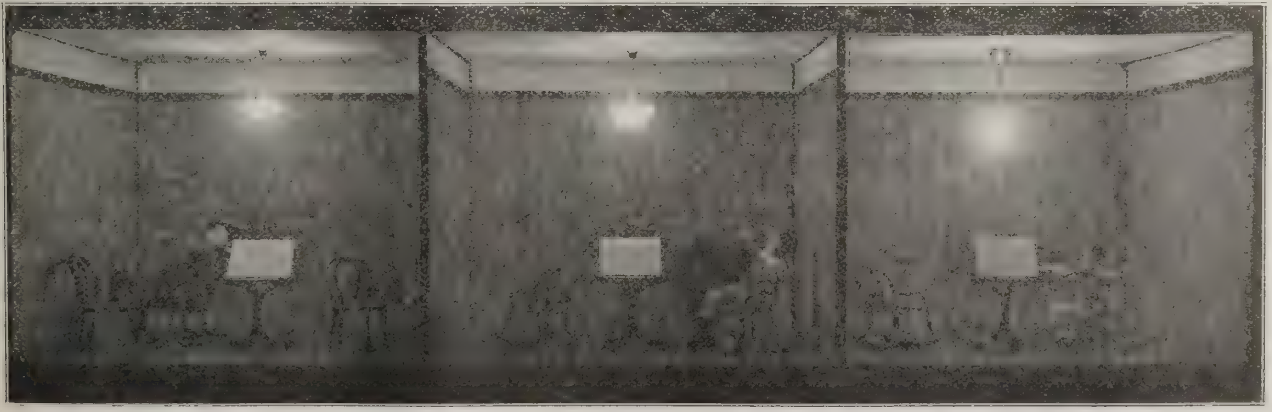


Fig. 11. Three Common Methods of Illumination.

FIG. 12. DECORATIVE OR ORNAMENTAL LIGHTING UNITS.

The horizontal illumination intensity on the table plane averages for the three ceilings:

White ceiling	100%
Light cream ceiling	87%
Dark cream ceiling	58%

showing a reduced efficiency of 42 per cent, due to the inferior reflecting qualities of the darker ceiling.

Following closely the development of the indirect lighting system came systems classed inaccurately as semi-indirect lighting units, in which part of the light is reflected from the ceiling, as in the indirect system, while part of it comes directly from the translucent bowl surrounding the light source. It is obvious, of course, that with any translucent lighting auxiliary employed in a direct lighting system, some of the light which reaches the ceiling and walls, is reflected downward, and that the system is thus a semi-indirect system. Those units which are classed as semi-indirect units at the present time are, however, units designed especially with a view to directing a considerable proportion of the light toward the ceiling. The most desirable combination of direct and indirect light for general purposes served by such units, is today a subject of discussion. Views of illuminating engineers vary in this matter. All kinds of relations between these two components are to be found represented by outfits now available in the open market. These range from equipments in which the transmitted light is so small a proportion of the total as to make it apparent that the purpose to be served by the direct component is chiefly one of decoration, to those in which the direct component is so large as to make evident an intention to increase the efficiency considerably by restricting the amount of light which is subjected to the inherent ceiling loss.

In the photograph (Fig. 11), three semi-indirect lighting fixtures are shown. In room No. 1, a direct lighting reflector is inverted. In room No. 3, a bowl, not intended for this purpose, is employed. The design of its surface is not well adapted to this purpose, and it is therefore not so efficient as it might otherwise be made. In room No. 2 a hemisphere is utilized, illustrating semi-indirect lighting in the simplest of its characteristic forms.

The three modern systems of lighting are represented in Fig. 12. In room No. 1, the direct lighting unit transmits sufficient light to make the walls pleasantly, but not objectionably, bright, while directing much of the light to the table plane. In room No. 2, the semi-indirect unit illuminates the card by light direct from the bowl and by light from the ceiling and walls in something like the proportions of 3 to 1. The relative direct and indirect components upon the table plane are of the order of $1\frac{1}{2}$ to 1. In room No. 3 all of the light is diffused from the ceiling. The ceiling is the brightest surface within view, the lamp being entirely concealed. The illumination is very soft and uniform.

Comparing the two end rooms, it will be noted that in room No. 1, the vertical stripes in the wall paper may be seen standing out clear and sharp. The character of the pattern is evident. In room No. 3 these stripes are seen somewhat less distinctly. This is due to the lower intensity of light on the wall. Still more important, however, as a factor, is the downward direction of the light from the ceiling. Viewed from the table, these stripes stand out distinctly as the angle and direction are then such as to be within the zone of strong specular reflection from the wall paper. Viewed as in the photograph, these stripes can hardly be discerned except on the upper part of the walls near the border. The paper loses its character. This is an excellent illustration of the importance of securing proper direction from the major part of the light, although it should not be taken as an indication that the direction is wrong in this installation because it must be remembered that the effect would be minimized if the wall paper were viewed from within the room, instead of from without.

With the conditions as established (and it is not claimed that they are more than suggestive of typical conditions) the card illuminations are as follows:

Room No. 1, 220 per cent; room No. 2, 100 per cent; room No. 3, 42 per cent.

It must be remembered, however, that the direct lighting unit in this case is favored, because the card is immediately beneath it at the point of highest intensity. For purposes of reading, as an example, it is difficult to judge from these figures as to the relative useful light. In the first place, questions of diffusion may result in establishing demands for higher intensities in one system than in another. This is one of the questions which is being very generally investigated at the present time, and in such a review as this, its discussion had no place. Dealing solely with the question of distribution, it may be noted that most reading would be likely to be done near the center of the room and that therefore the direct lighting system should receive some of the advantage in rating which the high intensity of the card immediately beneath the unit would appear to give it. The relative higher intensities in the corners of the room with the indirect, and to a lesser degree with the semi-indirect fixture, are not of much advantage from a practical standpoint. In this particular installation, with the

same flux produced by the lamps in each type of lighting, the average horizontal intensities are relatively:

Direct lighting, 1.61 foot candles; semi-indirect lighting, 1.33 foot candles; indirect lighting, 0.91 foot candles. It is generally believed that with conditions suitable for each system of lighting, the direct lighting system will deliver about twice as much light upon the table plane as does the indirect lighting system, while each will illuminate the walls moderately.

The decorative feature has kept pace with developments in the other branches of the art. Lighting auxiliaries are consistently being improved in appearance, as well as in other features of effectiveness. Efficiency of reflection, the necessary degree of diffusion, and the proper direction of light are being achieved more and more completely as experience becomes greater. In good taste and other qualities that make for pleasing effects, constant advances are being made also.

In the photograph (Fig. 13), may be seen illustrations of some of the more decorative types of fixtures and glassware now available in standard types. Whatever the character of the installation may be, it is more than likely that unless it is extraordinary, some fixture and some kind of glassware may be obtained which may be used in the installation with fair satisfaction. Unless installations are considered which are so unusual as to demand the design of special lighting equipments, those now obtainable must be considered to afford a very satisfactory range of selection.

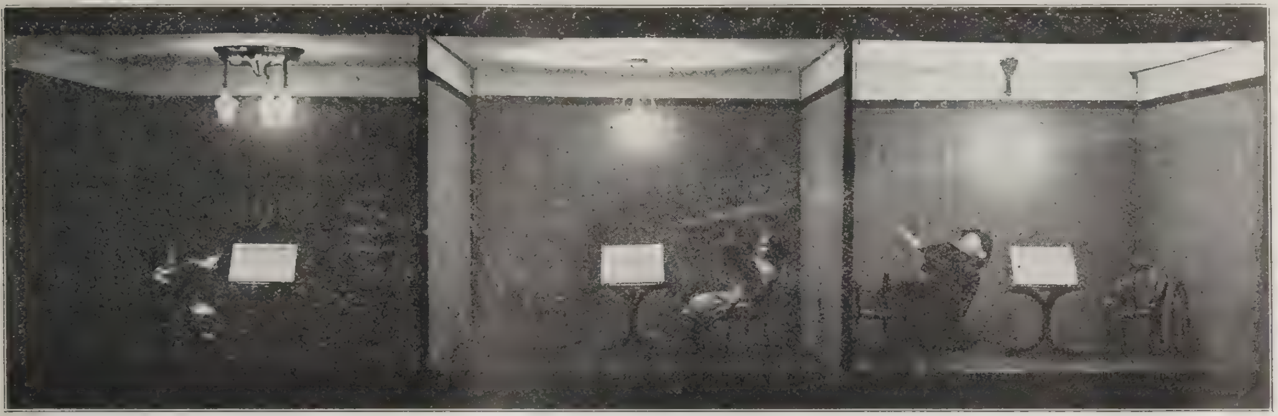


FIG. 13. THREE STOCK TYPES OF DECORATIVE FIXTURES.

Electrical Engineering in China.

A paper prepared by Prof. Middleton Smith, of the University of Hongkong, and read before the Hongkong section of the institution of electrical engineers on March 23, gives a considerable amount of information of value concerning electrical engineering in China and the state of the electrical development of the country. Prof. Smith states that in the whole of China there are three places only in which modern industrialism is even attempted—Hongkong, a British colony; Shanghai, an international settlement; and Hankow, another international settlement operating under somewhat different conditions from Shanghai. The writer considers the development in these places, however, as satisfactory object lessons, for the time being, to the Chinese of the advantages of electrical development.

Supply Companies in Hongkong and Canton.

Reviewing the general electrical situation in China it is stated that in the colony of Hongkong there are two public electricity supply companies. That which is on the island of Hongkong and which supplies the principal portion of the colony has a station with 2,000 kilowatt Diesel engines and 600 kilowatt steam engines, the understanding being, however, that the owners are planning a new steam turbine driven station. The other public utility company is on the mainland portion of the colony. Its station embraces 516 kilowatt engines, but 1,500 kilowatt is to be installed the current year. The local tramway is served by its own power station. The Taikoo dock yard is served by its own plant, which embraces a total capacity of 2,250 kilowatt.

The Hongkong and Whampao Dock Co. has a plant with a capacity of 500 kilowatts, but is preparing to abandon it and take current from one of the public supply companies. This company has on order and will this year install two 6-phase rotary converters (60 cycle) of 350-kilowatt capacity each. There are perhaps half a dozen other small generating plants in the colony, mostly driven by gas engines.

In Canton the public supply company uses steam and Diesel engines to the capacity of 1,540 kilowatts.

Shanghai Has the Model Plant.

In the opinion of Prof. Smith the electrical installation in Shanghai, which is owned by the municipality, dominates the entire electrical situation in the Yangtze Valley. The present capacity of the plant is 14,000 kilowatts, i. e., two steam-driven 5,000-kilowatt and one 4,000-kilowatt turbines. The plant has all the latest coal-handling and similar appliances and is considered the model plant of the Far East. Extensions up to an additional capacity of 20,000 kilowatts are planned.

Courage makes a man dominant and enables him to recover quickly from set backs.

The man who took his one talent and buried it was a pessimist. That's why he had only one talent.

Annual Convention of the N. E. L. A.

The thirty-eighth annual convention of the National Electric Light Association, held in the hall of the Native Sons' of the Golden West, San Francisco, California, June 8th to 11th inclusive, came to a close after one of the most interesting meetings ever held.

The session was called to order on Tuesday morning by President Holton H. Scott, who introduced Hon. John Rolph, Jr., Mayor of San Francisco. In a very cordial address of welcome the mayor touched upon the work done by Mr. W. D'arcy Ryan in planning the illumination for the exposition, and paid particular tribute to Mr. John A. Britton, Chairman of the Local Convention Committee, for his efforts in behalf of the visiting delegates.

E. W. Lloyd, President-Elect of the N. E. L. A...

President Scott's Address.

In his address, President Scott laid particular stress on the sale of service instead of current; the right of the company to at least half the benefits arising from improvements made in appliances; and on the tendency of the times to make it hard for public service companies to raise capital. He said in part:

"The tendency of the times is making it hard for public utility companies to raise capital, and if this continues it will retard the wonderful possibilities in the growth of the electrical business and the public will suffer. For instance, if our regulating bodies will not allow a return sufficient to attract capital, fewer extensions to residential customers will be made and the extensions to the rural districts will be postponed. It is a fact that the public is more interested in the ability of public utility companies to keep pace with the growth of the communities and to render good service than in the rate for the service. I am not a pessimist, for we know the men in our industry have solved many big problems in times past and they are capable of convincing the public ultimately that capital and brains should be rewarded liberally."

"One of the problems that confronts us all the time is that the public does not comprehend that we are selling a service, not a commodity, or kilowatt-hours. Neither does it know that while everything else is going up in price and we are paying more for our raw materials and labor, we are giving the public approximately six times as much light for $1 as we did fifteen years ago. The public is receiving all the benefits of the wonderful increased efficiencies of the incandescent lamps and at the same time, in many localities, is requesting a reduction in the rates per kilowatt-hour. It brings home forcibly to us that the sale of energy on a straight kilowatt-hour rate is not equitable, but that in addition to a rate for energy we should have a demand charge and a fixed charge per customer. I asked Mr. Thomas A Edison a short time ago how he first determined how to charge for electric energy, and he wrote the answer in his own hand as follows:

How Edison Sold Service in Early Days.

"'I sold light, never current. All lamps were 16-cp, and a lamp was called the equivalent of a gas burner supplied with 5 cubic feet of gas. Our charges were based on gas at $2 per 1,000 cubic feet, which was then the prevailing price.

"The reason I wanted to sell light instead of current was that the public did not understand anything about electric terms or electricity and had no confidence they ever could learn; but they did understand light, and it was light they paid for and we could make explanations they could comprehend.

"'Another reason why I did not want to sell current was that from my experiments I knew that the incandescent lamp was only the beginning, and that there were great possibilities of enormously

increasing its economy, and I thought that the pioneers should reap some reward for these improvements. It was my idea that of all the benefits which improvements in the lamps should attain, one-half should be given the public and one-half given the company. But, for some reason, after a few years the selling of current was introduced, thus destroying all chance of the companies' gaining any benefits from improvements; in fact, such improvements were a disadvantage, which to my mind is a poor business policy for the company and the public.'

"Mr. Edison is right when he says that the companies should receive at least half the benefits arising from improvements made in appliances.

Campaign to Increase Membership.

In referring to the membership of the Association, Mr. Scott called attention to the fact that although there had been an increase in the dues of Class A and Class D members, there had, nevertheless, been a substantial gain in membership. After giving careful consideration to the subject it had been decided to base the dues of Class D members upon their mercantile ratings, with a minimum annual fee of $20. There have only been a few withdrawals on account of this change, and it is expected that there will be such an appreciation of the value of membership in the Association that there will be no hesitation upon the part of the large majority of manufacturers to pay the increased dues. The company section membership has been steadily increased until there are at the present 9,000 such members.

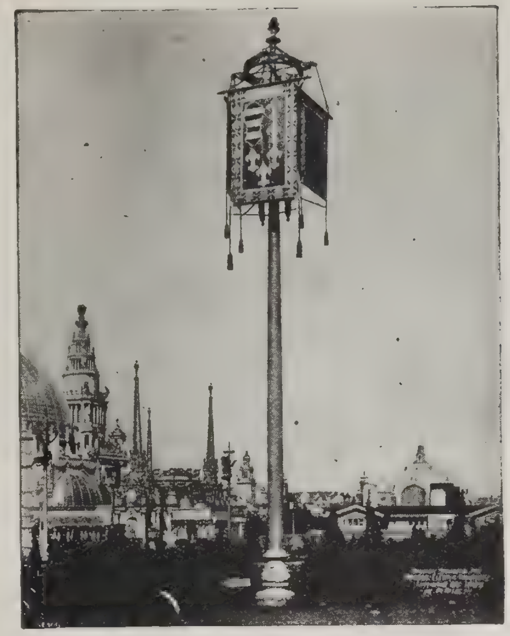
Mr. George Williams, chairman of the committee on organization of the industry, in his report recommended that the work of securing new members be carried on by the state sub-committees, as has been done during the past year. He called attention to the fact that there are more than 20,000 electrical men who are desirable and eligible for N. E. L. A. membership.

It was pointed out that although there have been losses in membership in nearly all other industrial and technical associations, the N. E. L. A. has gained in number, the membership at present and the increase during the year being as follows: Class A, 1,125 members, increase 34; Class B, 11,125 members, increase 308; Class C, 96 members, increase 23; Class D, 253 members, increase 3; Class E, 808 members, increase 23; foreign, 41 members; total membership, 13,448; increase, 431.

Owing to the absence of Mr. Williams, the report of the committee on organization of the industry was read by Mr. S. A. Sewall.

Report of the Secretary.

The secretary, Mr. T. C. Martin, presented his report which showed that a vast amount of work had been undertaken and carried out by the executive officers of the Association. There were sent out from the New York office an average of 300 letters



FRONT VIEW OF BANNER STANADRD WITH GE ORNAMENTAL LUMINOUS ARC LAMPS, PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

for every day in the yar. The amount of literature in the shape of bulletins and handbooks was enormous, 50,000 copies of the monthly Bulletin alone being distributed. The Lecture Bureau has done an immense amount of work also, and there are now available 35 lectures, illustrated with 1,400 lantern slides and two motion-picture films. The lectures have already been heard by over 40,000 members of the industry in 35 different cities and 25 states. Information on rates is being constantly gathered, and the available data on this subject augmented. There is every indication that this service is highly appreciated.

REAR VIEW OF BANNER STANDARD WITH GE ORNAMENTAL LUMINOUS ARC LAMPS, PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

President Scott complimented Secretary T. C. Martin upon the report of the Committee on Progress which he had presented, making special reference to the analysis and conclusions regarding municipal ownership of public utilities and the operation of municipally owned plants.

Notes of Interest.

The Committee on Doherty and Billings Prizes for Company Section Papers awarded the Doherty Gold Medal to W. D. Katzenberger, of Brooklyn, N. Y., for a paper entitled "Securing of Big Power Business." The Harriett Billings Medal was awarded to A. G. Paulsen, of Brooklyn, N. Y., for a paper entitled "Conditions for Securing Continuity of Central Station Service."

Amendments were made to the constitution providing for the formation of a Manufacturers' Section, to which all Class D and Class E members are eligible. The executive committee of the association will consist of the usual officers and nine members elected from Class A and Class B, together with the president or chairman of the Manufacturers' Section and two members of that section.

A dozen or more telegraphic greetings were read from men high in the electrical profession throughout the country. Thomas A. Edison in his message said:

"My hearty congratulations to San Francisco on its splendid exposition and on the celebration of National Electric Light Association day, marking an appreciation of all that electricity is now doing for the comfort and happiness of mankind."

Alexander Graham Bell's message was as follows:

"The great Panama-Pacific Exposition is already associated with the great transmission of speech across the continent this year and on National Electric Light Association day I am glad to note emphasis laid on the kindred arts of electric light, heat, power and transportation."

Mr. John J. Carty sent a message which was of special interest because it had been telegraphed over the transcontinental telephone line while the circuit was at the same time being used for telephone conversation, utilizing energy supplied by the central-station companies of New York, Pittsburgh, Chicago, Omaha, Denver, Salt Lake City and San Francisco, all members of the N. E. L. A.

SOUTH END OF THE PALACE OF MACHINERY SHOWING EXTERIOR ILLUMINATED BY GE ORNAMENTAL LUMINOUS ARC LAMPS, PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

Among others who sent messagese were Elihu Thomson, Newcomb Carlton, Clarence Mackay, Frank J. Sprague, Charles P. Steinmetz, Charles F. Brush, D. R. Street, C. A. Coffin.

Wednesday the Pacific Gas & Electric Company gave a dinner in honor of Mr. Samuel Insull at the Bohemian Club which was partaken of by many of the prominent men in the industry attending the convention. Immediately after dinner there was a special illumination of the Exposition grounds and fireworks for the benefit of the delegates.

Entertainments.

The lady guests and some of the delegates to the convention enjoyed an all-day sight-seeing trip to Mt. Tamalpais. From there the party took special trains to the summit, where an excellent view of San Francisco, the bay and the surrounding country was obtained. Luncheon was served in the tavern on top of the mountain. Leaving the summit, the party coasted down the incline in gravity-propeled cars to Muir Woods, where an opportunity of viewing the great redwood trees was afforded. In the evening several hundred attended the water pageant at the exposition grounds, given by the Hawaiians.

The afternoon of Thursday, the 18th, was set aside by the Exposition officials as N. E. L. A. Day at the fair, and the delegates went out to the Exposition grounds in a body in buses. There they were photographed in a group, after which they marched in column-of-six formation to Festival Hall, where they were addressed by Mr. John A. Britton, vice-president of the Pacific Gas & Electric Company, chairman of the day, and the personal representative of Governor Johnson of California. President Charles C. Moore of the Exposition followed Mr. Britton and presented to President Scott of the N. E. L. A. a bronze medal commemorative of the convention.

Election of Officers.

The following officers were unanimously elected for the ensuing year:

President, E. W. Lloyd, general contract agent, Commonwealth Edison Company, Chicago, Ill. Mr. Lloyd was born at Belleville, Ont., Can., on Feb. 1, 1872. He received his early schooling at Belleville, his family later moving to Erie, Pa., where Mr. Lloyd was graduated from the local high school in 1890. After working as a draftsman in the steel mills in Pittsburgh for two years, Mr. Lloyd accepted a similar position with the Crane Company at Chicago. In June, 1893, he accepted a position in the drafting department of the Chicago Edison Company, the

forerunner of the Commonwealth Edison Company. Later he was transferred to engineering testing work, and in 1897 he was made foreman of the company's construction department. There he remained until 1900, when he entered the company's sales department, handling the sales of the company's old apparatus and equipment and devoting considerable time to making valuations on isolated plants. In 1901 Mr. Lloyd was made assistant superintendent of construction, and in 1906 he was promoted to his present position of general contract agent of the Commonwealth Edison Company.

First vice-president, H. A. Wagner, vice-president, Consolidated Gas, Electric Light and Power Company of Baltimore, Baltimore, Md.

Second vice-president, W. F. Wells, second vice-president and general manager, Edison Electric Illuminating Company of Brooklyn, Brooklyn, N. Y.

Third vice-president, R. H. Ballard, secretary and assistant general manager, Southern California Edison Company, Los Angeles, Cal.

Fourth vice-president, R. S. Orr, general manager, Duquesne Light Company, Pittsburgh, Pa.

Secretary, T. Commerford Martin, New York City.

Treasurer, W. H. Atkins, general superintendent, Edison Electric Illuminating Company of Boston, Boston, Mass.

BAND CONCOURSE SHOWING GE ORNAMENTAL LUMINOUS ARC LAMPS WITH LEADED GLASS SHADES, PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

Assistant secretary and treasurer, Miss Harriett Billings, New York City.

Insurance expert, W. H. Blood, Jr., Boston, Mass.

New members of the Executive Committee to serve three years: J. E. Davidson, Portland, Ore.; H. C. Bradley, Boston, Mass.; H. C. Abell, Brooklyn, N. Y.; R. F. Pack, Minneapolis, Minn.

Experiences on Line Transformers

BY D. W. ROPER.

SPECIFICATION ON CONNECTION BOARDS.

The specifications require that: "The ends of primary coils shall be brought to a convenient connection board of porcelain or other suitable material within the case and so arranged that the primary coils may be put in series or in multiple," and also that: "Sufficient oil shall be furnished to completely immerse core, windings and connection board."

All of the manufacturers do not agree that the terminal board should be submerged. It has even been contended that the connection board could be so designed and located that the lightning would jump across the terminals of the primary coils or from the primary terminals to the cover before the potential across the terminals of the coils could rise sufficiently high to burn out the coils. In looking for evidence bearing on this theory it was found that the repair shops had been, for several years, removing the connection from all transformers that were rewound, and that the percentage of troubles on these transformers was less than with new transformers containing connection boards. An investigation was made of all the transformers whose fuses had blown during a severe lightning storm, and signs of arcing at the terminal board were found in a large percentage of the transformers. These facts seemed to indicate that the connection board was the cause of many of the troubles during lightning storms. For the purpose of checking this theory one circuit with a total of about 250 transformers was equipped with transformers having the connection boards removed or submerged.

		Location of connection boards	
		Above oil	Removed or submerged
1. Number of transformers		9,878	1,648
2. Fuses blown without damage to transformers	Number	770	56
	Percent	7.8	3.4
3. Coils burned out	Number	77	10
	Percent	0.78	0.61
4. Connection boards damaged, leads burned off, etc.	Number	36	0
	Percent	0.36	0
5. Total classed as burn-outs, sum of items 3 and 4	Number	113	10
	Percent	1.14	0.61
6. Total cases of trouble sum of items 2, 3 and 4	Number	883	66
	Percent	8.95	4.01

TABLE III. COMPARATIVE RECORD OF TRANSFORMER TROUBLES DUE TO LIGHTNING WITH TRANSFORMERS HAVING CONNECTION BOARD ABOVE OIL AND WITH CONNECTION BOARDS REMOVED OR SUBMERGED.

Careful records were kept during the succeeding year, but the results were disappointing due apparently to the

small number of transformers involved in the experiment. Before the following lightning season arrived, additional circuits were provided with transformers having the connection boards removed or submerged, so that the total number exceeded 1,600 transformers. The scheme of lightning protection was not changed so that the only difference between these transformers and those conforming to standard practise was the removal or submerging of the terminal boards. The results of this experiment for the year 1913 are shown in Table III. In this table, under the heading "Fuses Blown" are included all cases of trouble which involved blowing of the primary fuse but which left the transformer in operating condition. Under "Burnouts" are included all transformers which were not in condition for service and had to be replaced. The results as shown in this table indicate that the terminal board above oil is the cause of about 60 per cent of the trouble during lightning storms. The results further indicate that the connection board does not act as a lightning arrester in protecting the transformer coils from damage, but on the contrary that a larger percentage of coils are burned out when transformers are provided with such connection boards above oil than when they are removed or submerged.

It appears, therefore, that the standard specifications have taken a long step forward in specifying that the connection boards must be submerged under oil, but as only a small percentage of the transformers that are provided with connection boards are ever used on 1,100-volt circuits, it is therefore suggested that a further improvement could be made requiring that transformers for use on 2,000-volt circuits shall be furnished without connection boards and limiting the use of transformers with submerged connection boards to those companies which have 1,000-volt distributing circuits.

SPECIFICATIONS ON OIL.

The standard specifications require that the oil be furnished with the transformers. The situation with oil is somewhat similar to that regarding cut-outs. Each of the several manufacturers furnishes a different type of oil so that with several makes of transformers in use it would be necessary to keep on hand several kinds of transformer oil and to see that the proper kind of oil was sent out with each transformer. It is possible to obtain a good grade of transformer oil which is entirely suitable for use with all of the several makes of transformers now on the market. Therefore, it appears to be a better practise in purchasing transformers on specifications, to require that they shall be furnished without oil, and to buy the oil separately under proper specifications, provided, however, that the purchaser has suitable facilities for making the necessary tests.

DESIGN, MATERIALS AND WORKMANSHIP.

The standard specifications contain a paragraph reading as follows: "Action upon these features will be based on the requirements of the specifications and observations made while the apparatus is under test." Later in the specifications, under the head of "Basis for Comparing Guarantees," is a paragraph reading as follows:

In case the proposals offered by different bidders in accordance with these specifications guarantee core losses less than those specified in Table I, each watt of difference shall be avaluated at $0.88 for purposes of comparison. For the same purpose, copper loss shall be evaluated at $0.33 per watt for each watt difference between values specified in Table I and the full-load value guaranteed by the bidder."

An inference that can be readily drawn from these two paragraphs is that having passed the qualifying specifications and having been subjected to a critical examination while the transformer was under test, the several transformers furnished by the various manufacturers are then to be considered of equal value except as to the copper and iron losses and that the relative value of the transformers submitted by the different manufacturers can then be determined by the process of valuation above described. If this assumption was borne out by experience, then we would expect to find that the percentage of burnouts of the various makes of transformers from all causes during the period of the year was approximately equal. In Fig. 1 are shown the results of a recent year's experience with

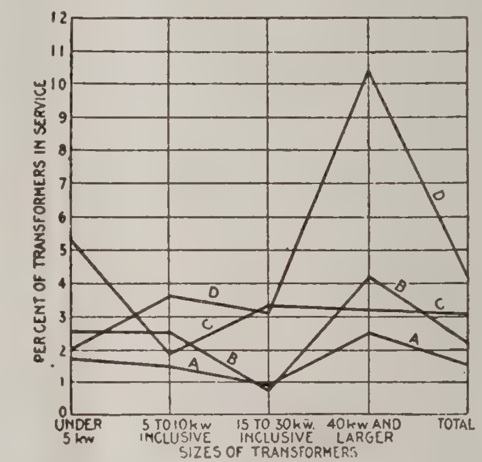


Fig. 1.

four different makes of transformers. All of the transformers included in these results have passed tests virtually identical with the qualifying specifications above referred to, but as shown by the figure there is a wide range in their ability to withstand the conditions of service. The percentage of burnouts in service for the best transformer was about one-third of the percentage for the rest. It is therefore, submitted that it should be possible to devise a specification so that there would not be as great a range in quality of the transformers which have passed the specifications.

In order that the cost of the transformer losses and the cost of repairs of the various types may be shown in their proper relation to each other, the results shown in Fig. 1 have been applied to the entire installation, assuming that all of the transformers on the system are of each of the several types, and estimates made showing what the total cost of repairs for one year would have been for each of these types of transformers. The iron and copper loss guarantees were also obtained from the same four manufacturers and the total losses for one year were calculated on the assumption that all of the transformers were furnished by each of the several manufacturers. The results of these calculations with different values assumed for the losses and for continuity of service are shown in Tables IV and V. It is not intended that the assumed values should represent the opinion of the author as to the value of these items, but they were assumed over a wide range for the purpose of showing the effect which these values would have in the selection of the best type of transformer for any particular set of conditions. An inspection of these tables shows that the determination of an operating

company of the best transformer for its purposes depends upon the values placed by it on the transformer losses and on the continuity of service. If it places a high value on the transformer losses, this feature will determine the best transformer for its purposes. The figures also show

	A	B	C	D
1. Cost of iron and copper losses at an assumed value of 1.5 cents per kw-hr...	$158,600	$148,300	$146,000	$154,000
2. Replacing and repairs....	7,700	11,100	14,900	19,800
3. Estimated loss of income, due to burnouts	265	370	510	675
4. Total of items 1, 2, and 3	$166,565	$159,770	$161,410	$174,475
5. Loss of prestige, (assumed as 15 times loss of income)	3,975	5,550	7,650	10,125
6. Totals of items 4 and 5..	$170,540	$165,320	$169,060	$184,600

Table IV. Operating Costs of Four Types of Transformers for the Year 1913, under Assumed Conditions.

that the cost of repairs is a comparatively minor item and that a high value must be placed on continuity of service in order that the savings due to the most reliable transformer may offset the cost of its increased losses.

THE PROTECTION OF TRANSFORMERS.

Transformers while in service must be protected from overloads and from lightning. It is customary to endeavor to protect against overload by means of primary fuses. In practise, a great many minor troubles occur on the premises of customers which will blow the primary fuses. Such troubles should result in the blowing of the secondary fuses on the premises of the customer and the primary fuses should not blow unless there is trouble within the transformer. To secure this result, the transformer must have primary fuses corresponding to several times its rated capacity, so that a slowly increasing load would burn out the transformer. Protection from overloads is best secured by proper records and by occasional tests as a check on the records. During the year 1913, the number of transformers burned out by overload was less than one-tenth of one per cent of the number installed. This record indicates the entire feasibility of protecting transformers against overload by means of the records and tests. The primary fuse should therefore be regarded as a device for disconnecting a defective transformer so as to protect the rest of the service, and not for the protection of the transformer itself from overloads.

	A	B	C	D
1. Cost of iron and copper losses at an assumed value of 0.5 cents per kw-hr............	$52,860	$49,450	$43,690	$51,500
2. Replacing repairs	7,700	11,100	14,900	19,800
3. Estimated loss on income, due to burnouts	265	370	510	675
4. Totals of items 1, 2, and 3..	$60,825	$60,920	$64,100	$71,975
5. Loss of prestige, assumed as 15 times loss of income)	3,975	5,550	7,650	10,125
6. Totals of items 4 and 5	$64,800	$66,470	$71,750	$82,100

Table V. Operating Cost of Four Types of Transformers for the Year 1913, under Assumed Conditions.

Protection of distributing transformers against lightning has apparently not received the attention that it deserves. The record of lightning troubles for the year 1913 is shown in Fig. 2. These results show that the larger sizes of transformers are comparatively immune from lightning, and that the greatest number of troubles occur with the smaller sizes, that is, the sizes below 10 kw. The number of transformers of these sizes comprise about 70 per cent of the total installation, so that the transformers which are most susceptible to damage by lightning are the most numerous. It is suggested that careful attention by the manufacturers

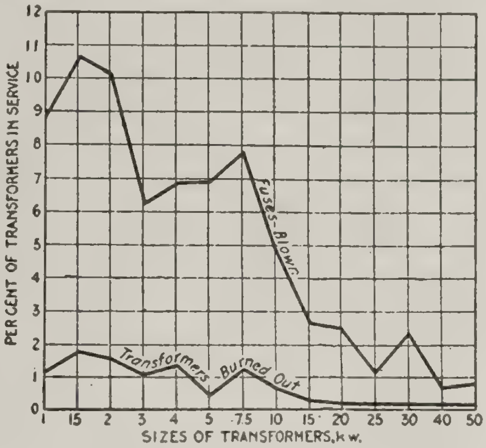


Fig. 2.

to the primary bushings, the clearance of the primary leads inside the case, the manner of their support and other minor details, would probably result in a material improvement in these records.

In addition to the experiments mentioned above, which involved the removal of connection boards from a large number of transformers, some further experiments were

	Ratio of arresters to transformers	
	40 per cent	100 per cent
Location of arresters.	On line poles	On transformer poles
Number of transformers	9,878	1,560
Fuses blown ....Number	770	85
Percent	7.8	5.[illegible]5
Transformers burned out ....Number	113	6
Percent	1.15	0.39

Note: All transformers had Connection boards above oil.

Table VI. Record of Transformer Troubles Due to Lightning, Showing the Improvement in Service Due to the Increased Lightning Arrester Protection.

made in another area, which consisted in installing lightning arresters upon the same pole with each of a large number of transformers. The remainder of the distributing system in question is protected by arresters not located on the transformer poles but scattered over the lines at a distance of about two thousand feet, resulting in a ratio of arresters to transformers of about 40 per cent. The result of these experiments are shown in Table VI.

In that portion of the territory where there was an arrester on the same pole with each transformer, the results to date as compared with the older practise indicate that the percentage of transformers burned out by lightning is reduced by about two-thirds. The several experiments indicate that by the combination of the two schemes and possibly by some further improvements in some details of the transformers and in the design of the lightning arresters, there should be no great difficulty in reducing the percentage of trouble due to lightning to one-fifth, and possibly to one-tenth, of those experienced in former years. It is hoped that more definite and complete information on this subject may be available within another year.

Suggestions Relating to Conduit Installation

BY CHAS. C. EVERS.

Many different schemes have been proposed for bending wrought iron conduit, and usually each is particularly applicable to some set of conditions. Three methods will be suggested in the following paragraphs, that have been found very satisfactory to certain work.

In Fig. 6 a scheme is illustrated whereby conduit of the larger diameters that cannot be readily formed by the ordinary methods can be bent into any contour desired. The bending force is applied through a set of pulley blocks, which very materially multiplies the power that a man can exert. When necessary, several men can pull on the fall line, and thereby supply a tremendous bending force. As suggested in the figure, a clamp to which a large round iron ring is attached is fastened to some member at the floor of the building, and a similar clamp is attached above the other at the ceiling. One hook of the blocks engages with a large ring that is placed over one end of the conduits, while the other hook hangs in the ring of the ceiling clamp. By changing the location of the ring on the conduit, and the position and height of the wooden blocking, the conduit can be formed into the shape required. Although the figure shows the method as applied in a building of steel construction, beam clamps can be designed whereby the method can be used in a structure of any type. The beam clamps shown in Fig. 6 are forged from 3 x 5/8 inch strap iron. The rings are of 6 inch internal diameter, and are welded from 3/4 inch round rod. The bolts are 3/4 inch.

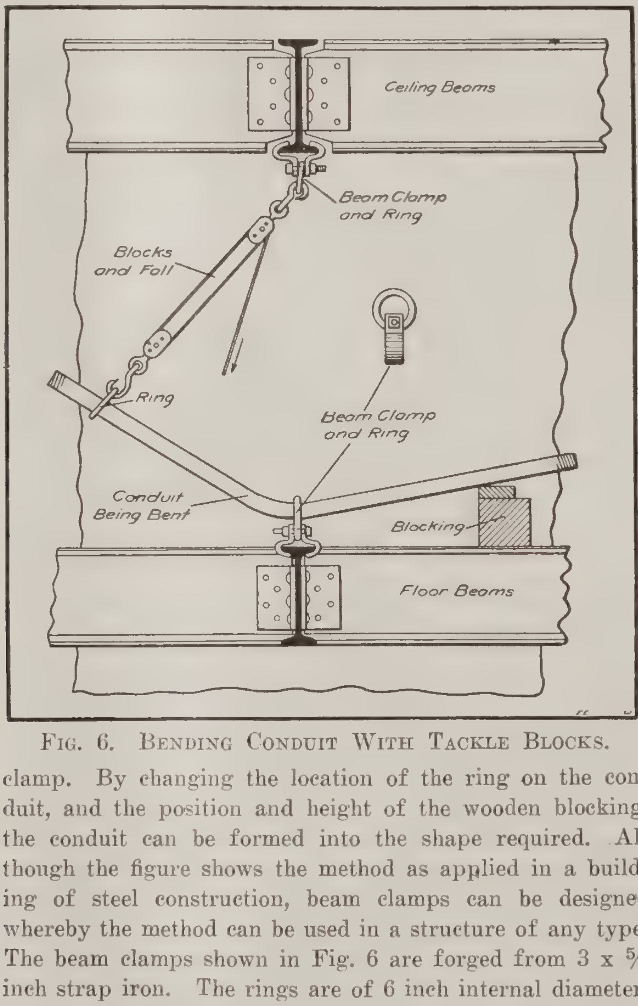


Fig. 6. Bending Conduit With Tackle Blocks.

A home-made bender that can easily be arranged at any job is suggested in Fig. 7. This is particularly useful for conduits of diameters between possibly 1 and 2 inches. The device consists merely of two blocks or cleats of 2 x 6 inch timber, preferably hard wood, either spiked or held with lag screws to a wooden column or post. By shifting longitudinally, the position of the conduit between the blocks and bending it a certain amount at each position, the tube can be formed into the curve that is necessary. The blocks should extend about 6 inches beyond the face of the post, and a semi-circular groove cut in each one close to the post will prevent the pipe from slipping out of place while it is being bent.

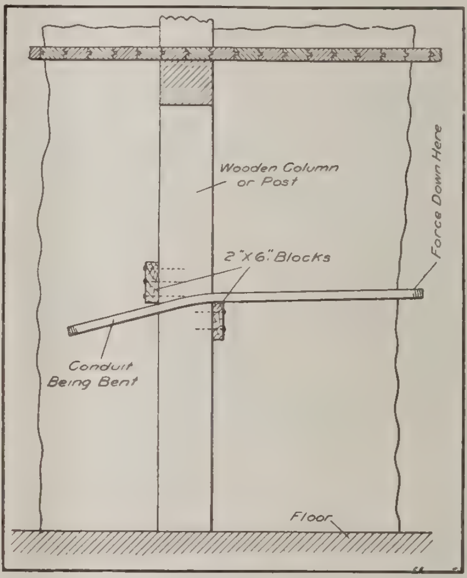


Fig. 7. Benders Made by Nailing Two Blocks on a Column.

An arrangement that can be conveniently used where several different conduit runs must all be bent to the same curve is shown in Fig. 8. This condition frequently exists where a number of conduit runs are brought up from a floor or down from a ceiling to a panel box, a pull box, or a switchboard. In such a case the method is as follows:

The wireman measures down from the ceiling or up from the floor to the level where the conduit runs are to terminate. Then a bending board is arranged as delineated in Fig. 8. Assuming that the distance from the finished floor line to the level where the conduits are to terminate is 23 inches, a spike is driven into the bending board 23 inches from the starting of the curve in the conduit, as shown in Fig. 8, and two blocks, one having a curved edge and the other a long narrow piece to hold the conduit securely in position while it is being bent, are nailed to the bending board. It is frequently convenient to arrange this device on the top of the wireman's working bench, although it can be constructed on a plank, and the plank then nailed to a column. To bend the conduits, it is only necessary to insert each between the two blocks so that its end butts against the nail, and then push on the free conduit end forming it around the curved edge of the bending

block. Where this procedure is followed all of the conduits will have turns of precisely the same radius, and the turns will all be the same distance from the end of the pipe.

Where a group of conduits bent as just described are to be installed in a concrete floor, they are of course placed in the forms or in the floor space before the concrete is poured. To insure that the exposed threaded ends will retain their alignment and elevation, a $1\frac{1}{8}$ inch plank about 6 inches wide and as long as necessary, should be

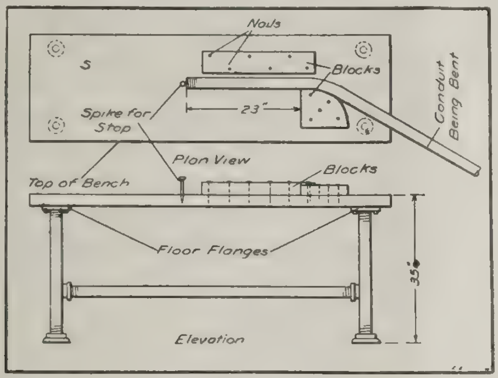


FIG. 8. FORM FOR BENDING CONDUIT TO EXACT CONTOUR.

used as a template. This template is firmly fixed in the required position by means of blocks, braces, and struts and as each conduit is placed in position, its end should be inserted in the hole bored (as indicated in the preceding table) for it in the template, and then firmly wired into that position. The template should be carefully laid out so that the distance between the centers of the holes bored in it will correspond exactly with the distance between the terminals immediately above, to which the conductors from the conduit will feed. After the concrete has been poured the template is removed, and the conduit ends will be in precisely the position that each should occupy, and all of the conduits will be parallel and their ends be the same distance from the floor line.

When bending a length of conduit by any of the ordinary methods, and the position of the bend is such that only a short length of the pipe extends beyond the bending block, the turn can be formed by placing over this short protruding end, a long length of conduit of a larger diameter. The large conduit will grip the smaller one firmly

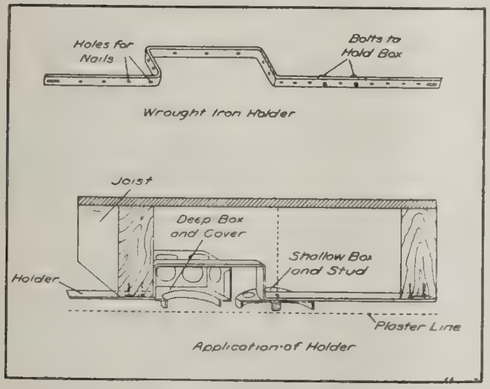


FIG. 9. WROUGHT IRON BOX HOLDER.

and its length will provide sufficient leverage, so that the pipe that is to be bent can be easily formed.

In wiring frame buildings with conduit, the usual practice with wiremen is to cut a block of a cleat to support every outlet box, that occupies a position between studs or joists. The finding of the material for these cleats or blocks, and the preparation and the fitting of the cleats which support them requires a considerable amount of time. It also requires time to make the rectangular hole for a switch box opening, or the round holes to accommodate the conduits that feed into the electrolier or bracket outlet box. Formed steel fittings have within the last year or so been placed on the market to support outlet boxes in positions such as those described. These fittings are so simple, and their prices so low, that if the wireman's time is worth the current rates, the iron fittings can be used in place of wooden blocks with material economy.

In Fig. 9 is shown a holder or fitting used to support electrolier outlet boxes in ceilings between joists. It consists merely of a length of channel section steel bent into the form of a yoke. As the illustration shows, deep outlet boxes can be supported by the U-shaped depression in the bar, while shallow boxes can be attached to the straight part. The bar is long enough to span joists spaced the standard distances apart. This fact, and the fact that the holder will accommodate either shallow or deep boxes, makes it pactically universal in its application for wooden building ceiling outlets. The cost of these holders is very low.

Another type of holder which is stamped from No. 14 gauge sheet steel, is shown in Fig. 10, and its construction and application is apparent from a study of that illustra-

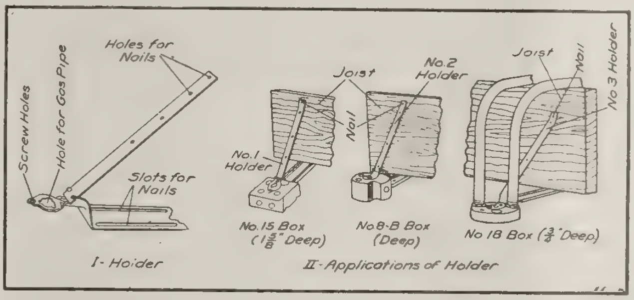


FIG. 10. OUTLET BOX HOLDERS AND APPLICATIONS.

tion. One feature of this stamped holder is that it does not obstruct the knockout holes in the bottoms of the boxes. One holder is designed for all standard boxes, for lath and plaster work, having depths of $\frac{1}{2}$ inch or $\frac{3}{4}$ inch; this holder can also be used for $1\frac{5}{8}$ inch deep boxes which will be installed without covers. The second style of holder is for lath and plaster work for boxes of a depth of $1\frac{5}{8}$ inch, but it can also be used without an open cover for $2\frac{1}{4}$ inch deep boxes. The third type is for boxes that are $\frac{3}{4}$ inch deep, that is, shallow boxes and can be effectively applied in communities where open covers or plaster rings are not mandatory. Any one of these three holders can be purchased for ten cents, or for less in quantities. Any construction man will appreciate that he cannot prepare, fit, and bore a wooden block to support an outlet box for ten cents' worth of time. In fact, the probabilities are that where metal holders are substituted for wooden blocks for supporting outlet boxes the saving in cost due to the economy in time will equal 25 per cent or even 50 per cent, over and above the cost of the holders.

Another type of box holder that can be used either in frame buildings or in terra cotta partitions for supporting switch outlet boxes is shown in Fig. 11. Some contractors have followed the practice in terra cotta work of allowing the conduit run to a switch outlet to hang down unrestrained from the ceiling, and have allowed the terra-cotta

masons to build their partitions around the box in accordance with their own fancies. The result has often been that the switch box opening has been out of plumb or out of line. Other contractors have devised holders whereby the switchbox was retained in a given position in relation

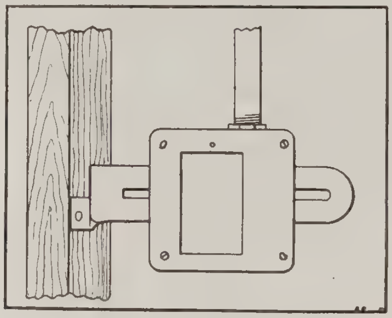


Fig. 11. Showing Application of Switch Box Holder.

to the door buck while the terra-cotta partition was being laid around it. Then after the partition had progressed far enough so that the box was firmly held in position, the holders were removed, because they were relatively expensive. The holder illustrated in Fig. 11 is so cheap—it costs only a dime or less—that the contractor can well afford to leave it in a terra cotta partition.

It is possible to do a great deal of effective head work in planning the conduit runs to serve a given building. A good wireman can effect a very material saving in time and in material by studying his conditions and planning his runs so that labor and material will be most effectively utilized. This situation can be examined very satisfactorily when two installations of exactly the same size and room lay-out are wired by different men. An example of such a study is shown in Fig. 12 which indicates the wiring plans of two different apartments, each of the same size and room layout, that were installed by different workmen. The economical layout (*A*—Fig. 12) was wired with 304 feet of conduit in 2½ days' time, while 340 feet of conduit and 3 days' time were required for the wiring of layout *B*, in which the outlets were identical with those of layout *A*. A study of these two diagrams should prove very helpful to a man who is interested in installing jobs with maximum economy.

(Concluded in August.)

Armature and Commutator Troubles—Their Cause, Effect and Repair

BY ALEX R. KNAPP.

REFILLING OF COMUTATOR.

When a commutator is to be refilled, obviously the first thing to do is to disconnect the armature leads and remove the commutator. A simple device for accomplishing this is shown in Fig. 8. Two long bolt rods are screwed into holes tapped into the sleeve ring, and a bar of heavy iron is placed across the end of the shaft, the bolt rods coming through, as shown. By tightening the nuts evenly, the commutator can be pulled off. Next count the number of bars carefully, and enter this in a note book for future reference. Remove the sleeve, and if possible save the mica rings. If these are in good condition they can be used again. Carefully caliper the diameter of these rings and enter this in the note book also, as the new commutator will have to be bored to fit these rings.

With a micrometer, measure the diameter of the thick and thin edges of one of the bars in thousands of an inch; also the thickness of the mica segment. It is best to order the bars and mica segments from the manufacturer sawed to the proper size, as in all probability this can be done cheaper than in an ordinary manufacturing plant not equipped for this work. When ordering, a clear and definite drawing should be sent, giving all necessary dimensions and allowing about one-eighth over the dimensions of the old bar for boring and turning purposes. Hard drawn copper is best, as it wears at about the same rate as the mica segments.

In order to assemble the commutator, a clamp will be necessary to hold the bars together while boring. Several makeshift methods are available, but it will pay to have an iron clamp cast at a local foundry and do the small amount of machine work yourself. The clamp should be bored one-quarter inch smaller than the diameter of the commutator, so that when it is drawn tight, there will exist a space of about 1-16 inch inch between the sections. Fig. 9 shows such a clamp.

Fig. 10 shows the method of building the commutator. *A* is the commutator, and *B* the clamp. Wooden blocks can be used to hold the clamp about midway of the commutator. *D* is an iron face plate. The clamp should first be placed on the the plate as shown, and the bars and mica segments stacked in a circular form within it. Care must be exercised

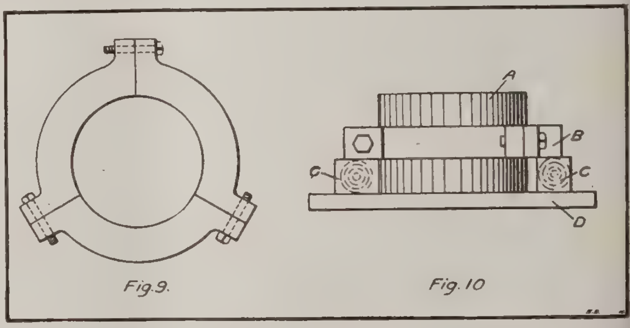


Fig. 9. Clamps for Holding Commutator Bars Together When Assembling. Fig. 10. Method of Building Up Commutator.

to make sure that a mica segment is placed between each copper bar. Count the bars carefully, so that their number corresponds with the number of bars in the original commutator.

Take several pieces of copper wire (about No. 9 B. & S. gauge and remove the insulation. Place these around the

commutator near the top and lower ends to act as band wires, and twist them tight. The clamp may then be removed, and the commutator straightened. The mica segments can be brought out even with the surface of the bars by holding the fingers against the inside edge of the segments and tapping the bars on the outside with a small hammer. Place a square or steel scale on the face plate and tapping the bars on the outside with a small hammer. Place the square or steel scale on the face plate and see that the bars line perpendicularly with one edge of the square. If they do not, a gentle pressure one way or the other on the top end of the commutator with the palm of the hand will bring them in line. See that each bar and segment is down flat against the surface of the plate, as this end will be fastened to the face plate on the lathe. Tap each bar and segment down solid with a square ended punch, a little narrower than the thickness of the bar. When this has been done, the band wires can be drawn a little tighter, and the surface of the commutator, where the clamp will fit, should be filed to remove any protruding mica, so as to present a smooth surface to the clamp.

Replace each section of the clamp about the commutator again using the wooden blocks mentioned before. Draw the clamp tight, being sure to leave the same amount of space between each clamp section. A small gas burner, or some other source of heat should be handy, and the commutator placed over it and heated. When a good heat has been attained, remove and tighten the clamps. Allow it to cool, and again tighten.

The next thing to do is to bolt the commutator to the face plate of the lathe and center it. The same wooden blocks can be used again for supporting the clamp. Face off the end of the bars, and then groove out the end for the taper rings to the same diameter as mica rings on the sleeve. Take one of the old bars, and with a bevel protractor determine exactly the taper used on the old commutator. The usual taper employed is shown in Fig. 11. A small groove (shown at A) should be cut below the intersection of the two tapers to allow room for the edge of the mica ring. The other end should be treated in the same manner.

When the boring has been completed, a close inspection must be made of all turned surfaces, to make certain no

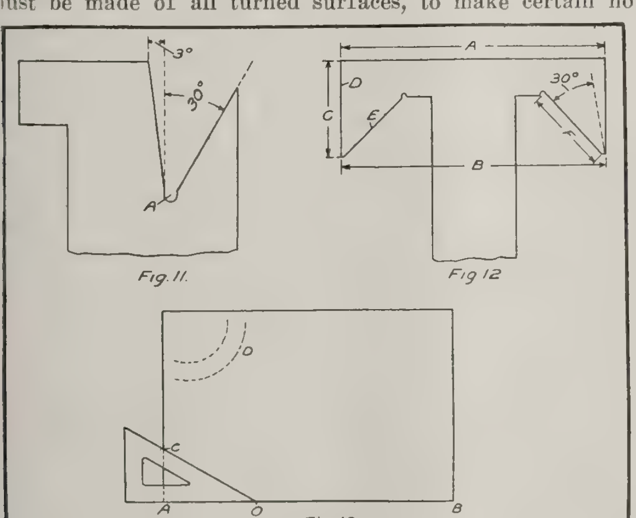


FIG. 11. SHOWING TAPER FOR BARS. FIG. 12. TEMPLATE FOR LAYING OUT MICA COMMUTATOR RINGS. FIG. 13. SCHEME TO SECURE TAPER E OF FIG. 12.

copper has been dragged over the mica, forming a short-circuit. The corners of the groove A, Fig. 11, should be carefully gone over, as it is here that drag-overs most frequently occur. Scrape and wipe the mica rings on the sleeve clean; also wipe out the inside of the commutator with a soft rag. Place the sleeve in the commutator again, and draw up on the end nut. On a refilling job, when the old mica rings are used over, there will most likely be found cracks between the band ring and the commutator copper due to the irregularity of the mica ring caused by the shape of the old commutator. These cracks can be filled by pushing in thin sheets of mica. Shellac should be used liberally on the ends.

Bake the commutator for about one hour until it becomes thoroughly hot, and tighten the nut. Reduce the heat somewhat, and bake over a slow fire until the shellac becomes hard. Tighten the nut again and allow to cool When cold give the nut a final setting up. The clamp can now be removed.

Sometimes it will be impossible to save the mica rings, and new ones will have to be made. These are made of flexible micanite, usually .030 inch thick. It is best to make the rings in three pieces to the layer on small commutators; three layers constituting a ring. When heated slightly, this mica can be bent around the sleeve to the desired shape. Trim the edge square on each piece and fit them tightly in the bore of the commutator. The taper rings should be fitted in the same manner, a slight space being left between abutting ends.

A good shop method for making a template to lay off these rings by, is as follows: Mark off on a piece of cardboard an arc of a circle, the radius of which is equal to the diameter A, Fig. 12. Strike another arc from the same center with the radius of the dividers made smaller by the distance C. This will give a templet for the band D.

A templet for the taper E can be prepared as illustrated in the following example: Assume diameter B to equal seven inches. Then in Fig. 13 lay off one-half this diameter, or three and one-half inches from A on the edge AB as shown at O. If the taper is 30 degrees as illustrated in Fig. 11, take a 30 degree scale and square its lower edge with the line AB, its apex, or point touching the point at O. Draw the line OC, which will be the radius of the arc of a circle D, shown dotted. Strike another arc from the same center with the radius made smaller by the distance F, Fig. 12. This will give a templet for the taper E.

In order to finish the commutator, turn out a mandrel to fit the bore of the sleeve, when the final finishing cuts can be taken. After finishing, a bar to bar test with the test lamp outfit should be made to be sure there are no short-circuits between bars. A test for grounds can also be made by holding one wire on the iron sleeve and passing the other from bar to bar around the commutator.

The slots for taking the armature leads must next be cut. It is well to cut them a little wider than the diameter of the lead wires. These slots should be cut in a milling machine if one is at hand, otherwise a hack saw can be used. Possibly two blades fastened together will give the required width of slot. The commutator can now be placed on the shaft, and the armature leads soldered in. It is a good plan to take a light finishing cut across its wearing surface when the job is finished in order to insure perfect roundness.

Installation, Operation and Maintenance

This section is devoted to practical suggestions, experience and data, and is open to all readers who have something to say on every day work and trouble in the plant or sub-station, on the line, in the factory, mill or elsewhere.

Permissible Explosion-Proof Electric Motors for Mines.*

By H. H. Clark.

Among its investigations dealing with the means of lessening such dangers as attend the use of electricity in the mining industries, the Bureau of Mines has undertaken one that has for its purpose the establishment of permissible explosion-proof motors for use in places where an electric spark or flash might ignite inflammable gases or dusts. This paper mentions the details of construction that the bureau considers essential for satisfactory service and describes tests of an explosion-proof mining-machine motor and accessories approved by the bureau.

The Bureau of Mines has applies the term "explosion proof" to motors constructed so as to prevent the ignition of gas surrounding the motor by any sparks, flashes, or explosions of gas or of gas and coal dust that may occur within the motor casing.

Before it undertook to establish a list of permissible motors the bureau made a large number of preliminary tests, the results of which are published in its Bulletin 46. No motors were approved as a result of this preliminary investigation, for none of the motors tested was considered to possess the characteristics of permissibility. As a direct result of these preliminary tests, the bureau decided to make tests to establish a list of permissible explosion-proof motors, and issued its Schedule 2, "Fees for Testing Explosion-Proof Motors." This schedule gave the general conditions under which motors could be submitted for test and the fees to be charged for making such tests. This paper sets forth more fully than Schedule 2, the details that the bureau considers essential to satisfactory explosion-proof motor construction.

The Bureau of Mines considers a motor to be permissible when it is the same in all respects as the sample motor that passed certain tests made by the bureau and used in accordance with the conditions prescribed by the bureau.

Before the Bureau of Mines approves any motor as permisssble there must be on file with the bureau the following data to be used for the identification of the motor and to be mentioned in the published approval of the motor.

1. The complete rating of the motor in accordance with the 1914 standardization rules of the American Institute of Electrical Engineers.

2. Dimension drawings that show clearly—

a. The size and general appearance of the motor casing.

b. The size and details of the protective devices and their relative arrangement on the motor casing.

c. The relative arrangement of parts within the motor casing.

d. The same information in regard to the starting rheostat as is requested for the motor.

e. Any other drawings necessary to identify or explain any feature that was considered in the approval of the motor or its accessories.

The design and construction of permissible explosion-proof motors and their accessories must be especially durable. This requirement will be applied consistently to all the details of the machine, as well as to its principal parts, in order to be assured that, under the severe conditions imposed by mining service, the explosion-proof qualities of the equipment will remain unimpaired.

The protective devices used with permissible explosion-proof motors must not only be capable of preventing the passage of flames from the interior to the exterior of the motor casing, but such devices must also possess sufficient mechanical strength to insure against the accidental destruction of their protective qualities. If there are moving parts in connection with such devices, these parts should be so designed that there can be no interference with their movement.

Starting Rheostats.

Starting rheostats and other necessary equipment that may cause an ignition of gas must be protectd as adequately as the motor itself. The casings of starting rheostats must be explosion proof. The resistances and contacts of the starting rheostats used with portable motors of not more than 50 horsepower capacity should be inclosed in the same box, unless inclosed in separate boxes connected by approved piping through which all leads are carried. All leads entering the explosion-proof casing of a starting rheostat should pass through the casing in the form of properly protected insulated studs of approved design. The use of rubber bushings will not be approved because the bushing may become displaced and thus destroy the explosion-proof quality of the casing. The casing of the starting rheostat should be mounted on the motor casing, if possible, and the intercommunicating openings for the passage of leads should be made large in order to prevent the rise of pressure that always attends the propagation of an explosion through a small hole from one compartment to another.

*Technical paper 101, Bureau of Mines.

If it is not possible to mount the starting rheostat on the motor frame, all leads connecting the starter with the motor should be carried in rigid metallic conduit.

Unless means for opening the circuit both automatically and by hand are provided in a separate explosion-proof casing, they should be incorporated in the design of the starting rheostat. If the starting rheostat is mounted on the frame of the motor, provision should be made for entirely disconnecting the electric circuit from the starting rheostat.

Motor Casing.

All joints in the casing of a motor or of any of its accessories must be metal to metal joints with faces not less than 1 inch wide, and if the pressure developed in the motor casing by explosions can exceed 50 pounds per square inch the faces must not be less than 1½ inches wide. All bolt holes in casing must be bottomed or so arranged that the accidental omission of a bolt will not give an opening through the casing. All openings in the motor casing other than those provided with protective devices by the manufacturers must be tightly closed. It is desirable that such openings be as few as possible. There should be no exposed terminals or contacts outside the motor casing. If there are glass-covered openings in the casing of a motor, the glass should be of ample thickness and should be protected by strong metal covers that close automatically unless held open by hand. Armature bearings must be so designed that under no circumstances can an explosion be propagated from the interior of the motor casing around the armature shaft or through the oil wells.

Cable Reel and Trailing Cable.

If there are any sliding or rubbing contacts in connection with the cable reel, such contacts should be provided with explosion-proof protection, and any plug connections should be constructed so that they will be explosion proof. At the point where trailing cables enter the frames of portable motors, the cable should be protected with suitable armor or flexible metal conduit, securely fastened on the frame of the motor, and of a sufficient flexibility to prevent short bends occurring in the cable. The cable should not be fastened to this armor, but there should be provided inside the frame of the motor, an insulated clamp of approved design for securely fastening the cable and taking all mechanical strains that may be put upon it.

Tests.

In testing a motor to establish its permissibility, the motor casing will be filled and surrounded with the most explosive mixture of Pittsburgh natural gas and air. The motor will then be operated at its rated speed and the mixture within the casing ignited by a spark plug, by a spark from the motor brushes, or by any other means that simulates the conditions of actual practice.

Similar tests will also be made with greater and with less amounts of gas in the explosive mixture and with coal dust sifted into the motor casing or into the protective devices.

Tests will also be made to determine the point of ignition that gives the greatest pressure, and tests will be made by igniting from such a point. Not less than 50 tests of all kinds will be made, and more than that number may be made if, in the opinion of the bureau's engineers, more tests are necessary to prove the permissibility of the motor. In order for a motor to pass these tests, it shall in none of them cause an ignition of the gas surrounding the motor or discharge flames from any part of the motor casing. Neither shall the motor develop dangerous afterburning or excessive pressure in the casing of the motor or its starting rheostat.

The term "afterburning" as used in this report is applied to the combustion, immediately after an explosion within an explosion-proof casing, of a gaseous mixture that was not within the casing at the time of the explosion, but was drawn in subsequently while the products of the explosion were cooling.

Even after having passed the tests just described, motors or equipments will not be regarded as permissible if used under any of the conditions outlined below:

If used without the caution plate mentioned hereafter.

If used with openings in the motor casings other than those openings provided with protective devices by the manufacturer.

This condition refers to all openings but especially to removable covers.

If the motor or equipment when in operation is not complete with all of the parts considered in the approval of the motor or equipment.

Caution and Approval Plates.

As part of the protection of a permissible motor, the manufacturer shall be required to attach to the motor frame a metal plate inscribed as follows:

CAUTION.

> The permissibility of this motor depends upon the absence of any openings in the casing other than those provided with protective devices by the manufacturer.
>
> Cover plates should be screwed on tight and the casing frequently inspected for improper openings.

The manufacturer shall be permitted to attach to the motor frame a plate inscribed as follows:

PERMISSIBLE EXPLOSION-PROOF MOTOR.

SEAL.

Approval No. ———.

Issued to the ——————Company.

The size, material, and design of both caution and approval plates shall meet with the approval of the bureau.

The caution and statement of approval may be combined upon a single plate, a suggested form for which is shown below:

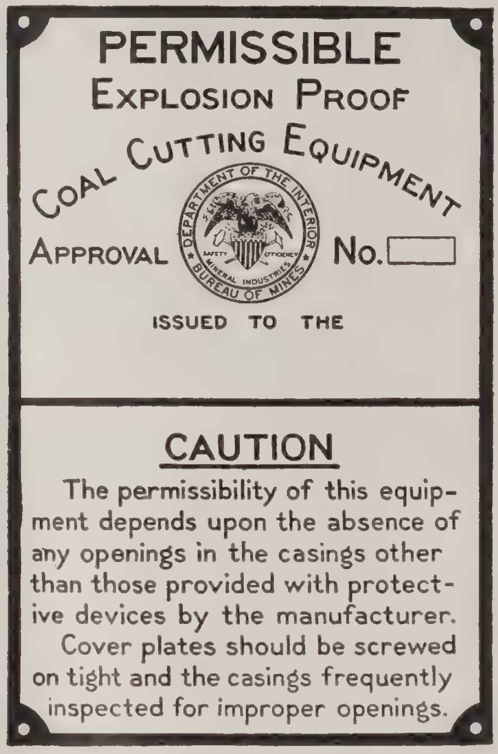


Fig. 1.—Suggested approval plate.

Notification of Manufacturer.

As soon as the bureau's engineers are satisfied that a motor is permissible for use where gas may occasionally be present in explosive proportions, the manufacturer shall be notified to that effect.

As soon as a manufacturer receives formal notification that his motor has passed the tests prescribed by the bureau, he shall be free to advertise such motor as permissible and may attach approval plates to such motors.

Drawing List of Approved Motors.

Since the safety of an explosion-proof motor depends largely upon its construction, the approval of a motor must identify the details of construction upon which the approval is based. This identification will be accomplished by reference to a list of drawings and photographs that describe in detail such parts as directly or indirectly affect the safety of the motor or any of its accessories. Each list of drawings will be given a number to facilitate reference. A copy of each drawing will be filed with the Bureau of Mines, although only a few of the drawings may be reproduced in the description of the motor that is published by the bureau.

Scope of Approval.

The bureau's approval of any motor shall be construed as applying to all motors of that specific type, class, form, and rating, made by the same manufacturer, that have the same construction in the detalis directly or indirectly affecting the safety of the motor, but to no other motors.

Manufacturers shall, before claiming the bureau's approval for any modification of an approved motor, submit to the bureau drawings that shall show the extent and nature of such modifications, in order that the bureau may decide whether or not it will be necessary to test the remodeled motor before approving it. Each approval of a permissible motor will be given a serial number.

Withdrawal of Approval.

The bureau reserves the right to rescind for cause, at any time, any approval granted under the conditions herein set forth.

Precautions.

It is obviously futile to protect the motor and neglect to safeguard any spark-producing accessory apparatus, such as rheostats, switches, and fuses. It is equally unavailing to protect all of the apparatus if, within the limits made dangerous by the presence of gas, there are used in connection with the electrical equipment uninsulated wires or wires not installed in suitable insulators and in a first-class manner. The protection of the electrical system in gaseous places must be made consistently complete.

New Officers for Illuminating Engineers.

At the recent election of the Illuminating Engineering Society which closed May 25, the following officers of the society and its several sections were elected for various terms beginning October 1, 1915:

President, Dr. C. P. Steinmetz; general secretary, Alten S. Miller; treasurer, L. B. Marks; vice-president, Clarence L. Law and J. L. Ninick; directors, W. A. Durgin, M. Luckiesh, and J. Arnold Norcross.

Chicago Sections: Chairman, E. W. Lloyd; secretary, O. L. Johnson; managers, A. O. Dicker, H. M. Frantz, C. A. Luther, A. H. Meyer, and P. A. Rogers.

New England Section: Chairman, Louis Bell; secretary, S. C. Rogers; managers, J. W. Cowles, W. B. Lancaster, George P. Smith, Jr., H. F. Wallace, and R. C. Ware.

New York Section: Chairman, D. McFarland Moore; secretary, Norman D. Macdonald; managers, Thomas M. Ambler, L. H. Graves, W. F. Little, E. R. Treverton, and Herbert S. Whiting.

Philadelphia Section: Chairman, George S. Crampton; secretary, L. B. Eichengreen; managers, George S. Barrows, Douglass Burnett, C. E. Clewell, R. B. Ely, and C. E. Ferree.

Pittsburgh Section: Chairman, Lewis J. Kiefer; secretary, R. H. Skinner; managers, Henry Harris, H. S. Hower, Harold Kirschberg, H. H. Magdsick, and G. W. Roosa.

The proposals to amend the constitution of the

society were also adopted by a vote of more than six to one. The principal amendments include provisions which create a grade of membership to be known as members. The requirements for admission to this grade, as at present set forth, are somewhat higher than those of the other grade of individual members known as associate members. The annual dues of members will be $10.00, and of associate members $5.00.

Charles Proteus Steinmetz.

Charles Proteus Steinmetz.—Born April 9th, 1865, at Breslau, Germany. Educated at the gymnasium (high school) and then at the University of Breslau, where he studied mathematics and astronomy, then physics and chemistry, and finally for a short time medicine and national economy. Involved in the social democratic agitation against the government, he escaped to Switzerland in 1888, and there studied mechanical engineering at the Polytechnische Zurich.

In 1889 he immigrated to America, and found a position with the Osterheld & Eichemeyer Manufacturing Company, first as draftsman, then as electrical engineer and designer, and finally on research work in charge of the Eichemeyer laboratory.

With the absorption of the Eichemeyer interests by the General Electric Company, Dr. Steinmetz joined the latter, and was attached to Mr. H. F. Parshall's Calculating Department in Lynn, Mass. With the transfer of the Company's headquarters to Schenectady in the spring of 1894, Dr. Steinmetz organized and took charge of the calculation and design of the Company's apparatus, and of the research and development work.

Alten S. Miller.

Alten S. Miller was born in Richmond, Va., in 1868 and graduated from Stevens Institute of Technology in 1888 with the degree of Mechanical Engineer.

After leaving college he went with the United Gas Improvement Company of Philadelphia, and the same year was sent by that Company to Omaha to take charge of its gas works in that city. In 1892 he went to Chicago as Western Sales Agent of the United Gas Improvement Company and spent two years in that position.

In 1894 Mr. Miller went to New York, as Engineer of the East River Gas Company of Long Island City. This company was then running a tunnel under the East River and building a plant to make gas in Long Island City, which was to be sold in New York. This company was later consolidated with one of the New York companies, forming the New Amsterdam Gas Company, and Mr. Miller was made the engineer of the latter.

In 1909 he went to St. Louis as President of the Union Electric Light and Power Company of that city. Here much was accomplished in reducing operating expenses and in gaining for the company the confidence and good will of the public. Much time was also spent in valuing the property and in the other details of a rate case before the Public Service Commission.

In 1911 he came to New York and joined Dr. Alexander C. Humphreys in the company Humphreys and Miller, Inc. Since then he has confined his work to Consulting Engineering. He has made a special study of valuations and rate cases in connection with public service properties.

Alten S. Miller.

Questions and Answers from Readers

Readers are invited to make liberal use of this department for discussing questions, obtaining information, opinions or experiences from other readers. Discussions and criticisms on answers to questions are solicited. However, editors are not responsible for correctness of statements of opinion or fact in discussions. All published answers and discussions are paid for.

Rates for Furnace Service.

Editor Electrical Engineering:

(534) (1) How is electric furnace service furnished and at what proportionate price? Which is best for this service, 110 volt direct connected or alternating current, and what is the best voltage for the latter? Furnace heat must be variable. Show wiring diagrams from 2,300 volt alternating current system 60 cycle and 110 volt direct connected system.

(2) What is the average rate per kilowatt hour in towns of less than 2,500? Is a special rate made for fan service? How are the rates determined and where can full details be obtained? Do any companies use flat rates? How determined and with what results? J. R. R.

Effect of Crossed Phase on Reading of Wattmeter.

Editor Electrical Engineering:

(535) Please answer the following:

What effect, if any, will a crossed phase on a 2,300 volt line have on the reading of a wattmeter? Will this cause a motor to heat and show overloaded? I have connected 24 lamps in series and they will burn on any two of these terminals of this line. J. R. R.

Cleaning Fields of Turbo-Generators.

Editor Electrical Engineering:

(536) (1) How often is it necessary to go to the expense of removing the fields of turbo-generators for the purpose of cleaning? Ought every two months to suffice?

(2) One terminal of current and potential instrument transformers is painted red to indicate polarity. What use is made of this, and what is the result of disregarding it?

(3) We operate a number of 10,000 volt circuits from 10,000 volt generators, but experience considerable trouble due to the circuit breakers opening on temporary short circuits. If we remove the overload tripping device on the circuit breakers, would service be improved, or would matters be worse? C. H. D.

Testing Efficiency of Synchronous Motor Generator for Exciting Alternator.

Editor Electrical Engineering:

(537) We have in our plant one Westinghouse synchronous motor, serial No. 1239036; 150 pounds; output, 2,200 volts; 25 cycle, 3 phase, 29.9 amperes, 750 revolutions per minute, direct connected to direct connected interpole generator No. 190. Type SK compound wound, 100 kilowatt, 800 amperes, 125 volts.

Also three 27.5 kilowatt compound wound direct connected generators, belt connected to pulleys on alternator shafts. At present we are using the synchronous motor generator set for excitation on all our alternators, only using the belt connected exciters for starting up purposes, leaving the belts on, but no voltage built up.

Please furnish me information how to make an efficiency test of the synchronous motor generator set as compared with the belt driven units, so that I may be able to determine the exact difference in cost of operation between the two systems; also showing the advantage, if any, of operating the synchronous motor and the manner in which this advantage may be determined by actual operation.

T. C. M.

Wiring a House.

Editor Electrical Engineering:

(538) I have a house to wire; living room and up hall are on double set 3 way switches. Living room fixture is wired for 1 light, and 4 lights taking two switches. Kitchen, den, bathroom, two lights. Two bed rooms are independent of switches. Dining room fixture is wired for two switches. What I want to know is how to wire the living room, dining room, den, kitchen, up hall, the two bath room lights and the two bed room lights. All lights I have mentioned to be controlled by a switch placed in one of the bed rooms, and when bed room switch is not in use, to leave all lights to be used in their regular way as though this extra switch was not on the lights I have mentioned. I can wire the house outside of this switch controling the lights I have mentioned. M. M. B.

Why Generator Would Not Build Up. Ans. to Ques. 509.

Editor Electrical Engineering:

It is evident that the series and shunt coils were opposing each other; whereas, they should be connected so that they should aid each other.

That they were in opposition seems proven by the fact that the machine built up with series coil alone in circuit.

It is suggested that the series coil be disconnected, and the shunt coils connected anew, so that the machine may build up as a shunt, leaving the external circuit open until she is up to speed. Care must be exercised so that sufficient load shall be thrown on, preventing too low resistance, for it is well known a shunt wound dynamo will drop its voltage entirely if the external circuit is of too low resistance. When the machine builds up as a shunt, then connect the series field as related. J. B. D.

Corona and Skin Effect. Ans. to Ques. No. 512.

Editor Electrical Engineering:

Corona. Houston's Electrical Dictionary says: "A crown shaped appearance sometimes assumed by the Auroral light. Whatever may be the exact cause of auroras, their appearance is almost exactly reproduced by the passage of electrical discharge through vacua."

In Architecture and Anatomy, "Corona" refers to things crown-shaped.

Nordenskiold stated that the terrestial globe is perpetually surrounded at the poles with a ring or crown of light, single or double. The outer edge of this ring he estimates to be 120 miles above the earth's surface, and its diameter about 1,250 miles. He calls it the "aurora-glory." Some have styled it Corona.

Skin-effect. (Houston's Electrical Dictionary.) The tendency of alternating currents to avoid the central portions of solid conductors, and to flow or pass mostly through the superficial portions. The so-called skin-effect is more pronounced the more frequent the alternations.

J. B. D.

Grounding of Conduit, Ans. Ques. No. 517.

Editor Electrical Engineering:

When wiring is installed as required in section 26, rule (e) of the National Electrical Code, it is protected by circular loom. If conduit is used as allowed in section 28, rule (f), it is an additional protection and must be large enough to take the wire and loom. The loom is considered sufficient protection from "shorts" and "grounds" and there is no necessity for grounding the conduit.

Homer C. Stiff.

Grounding of Conduit, Ans. Ques. No. 517.

Editor Electrical Engineering:

In answer to S. P. F. as to why conduit should be grounded, I believe that his query will be fully answered by reading the article "IRON CONDUIT WORK FOR INTERIOR WIRING AND POSSIBLE FIRE RISKS," by Mr. V. C. Wynne, in the April issue of *Electrical Engineering.*

Short sections of conduit for side wall protection are usually not over seven or eight feet long. A portion of rule 26, section e, in regard to side wall protection reads as follows: "When metal conduit or pipe is used, the insulation of each wire must be reinforced by approved flexible tubing extending from the insulator next below the pipe to the one next above it, unless the conduit is installed according to No. 28 (sections c and f excepted), and the wire is approved for conduit use."

From the several rules, I understand that the underwriters will permit two methods of conduit side wall protection. One method is to not ground the conduit, but reinforce each wire with circular loom, which I suppose is considered as sufficient protection against grounds. The other method is to ground the conduit, and use approved wire.

Alex R. Knapp.

Selection of Brushes for Generator. Ans. Ques. No. 518.

Editor Electrical Engineering:

The writer considers it advisable for L. J. C. to slot his commutator, as in all probability he will find this to be about the only permanent cure for the conditions he mentions, providing there are no defects in the armature windings, or shorts between bars. In a commutator in which the mica is of too hard a grade, or the copper too soft, an abrasive brush that will grind down the protruding mica will give better results than one that does not contain any abrasive material. Abrasive brushes, however, wear the commutator, and cause heating.

By slotting the commutator carefully, and installing graphite or other soft grade of brush, L. J. C. will find operating conditions greatly improved, with slight wear and a cool running commutator.

Alex R. Knapp.

Selection of Carbon Brushes, Ans. Ques. No. 518.

Editor Electrical Engineering:

The following is offered in reply to question No. 518, appearing on page 148 of the April, 1915, issue of *Electrical Engineering.*

Ordinarily the terms hardness and abrasiveness are generally confused when used in connection with carbon brushes. There are grades of brushes on the market which are very hard and have but slight abrasive or grinding action on the commutator. If the hard brushes used on the machine in question were not abrasive, probably satisfactory operation could be obtained by the use of a brush that contains abrasive material. This would have a tendency to keep the mica flush with the copper of the commutator. An abrasive brush does not necessarily have to be hard. A soft graphite brush containing abrasive material would give the desired grinding effect. In selecting a brush the peripheral speed of the commutator, the current carrying capacity required of the brush are also determining factors and should be considered.

In regard to slotting the commutator, it is considered good practice to slot commutators whose peripheral speed is above 500 feet per minute. Of course, the surrounding conditions must be taken into consideration before slotting. For instance it would not do to slot a commutator operating in a dirty or dusty place or in any place where it would be subjected to fumes, etc. Cleanliness is absolutely necessary for the successful operation of slotted commutators. It is generally true that slotting will allow better contact for the brushes on the commutator and will also result in cooler operation. If the commutator is slotted in this case it may also require a change in the grade of brush.

A. Braggini.

Selection of Brushes for Commutator, Ans. Ques. No. 518.

Editor Electrical Engineering:

Whether it is practical or not to slot a commutator depends upon the tools at hand and the ability of the operator. I would suggest as an alternate plan that L. J. C. use part graphite and part hard carbon brushes. The hard carbon brushes will cut down the mica and the graphite give proper lubrication. The brushes must be properly staggered so that every space gets its proper lubrication and the abrasive action of the carbon brushes. The hard carbon must not be all set on one holder stud as this will interfere somewhat with commutation.

H. E. Weightman.

Operation of Rotary Converters, Ans. Ques. No. 519.

Editor Electrical Engineering:

The advantage of operating a rotary converter or any other piece of alternating current apparatus at or near unity power factor is the decreasing of heating due to so-called wattless current. Since the heating of the apparatus determines the maximum load that the piece of apparatus can safely carry, the higher the power factor, the more load a given machine can stand.

A gain in efficiency is also obtained, as heating means a loss, but the percentage increase in the efficiency is not necessarily equal to the increase in power factor, as some of the losses depend upon other factors than the load current.

For the operation of rotary converters, *Electrical Engineering* for February and March of this year contained valuable articles by Mr. William R. Bowker, and Mr. W. E. B. is referred to these articles for a fuller answer to his question.

Grounding 3-Wire, 110-220 Volt System, Ans. Ques. No. 520.

The life hazard when working on a 3-wire, 110-220 volt circuit, with the neutral wire grounded is not increased over that when working on a similar connection of a like circuit not so grounded. Quite the contrary, with the intentionally grounded circuit, the hazard is practically eliminated, as the earth and all other "grounds" such as pipes, damp floors, metal beams, etc., become electrically a portion of the neutral wire, and the voltage between an "outer" and the "ground" is that between the "outer" and the neutral.

But if the circuit is not so grounded, then the life hazard is always present to an unknown degree, as the outer or neutral wire may become accidentally crossed with a high potential wire, such as a primary, a live street series circuit or a trolley wire, and a person touching any of the three wires of the supposedly 110-220 volt circuit while standing on the moist earth or a metallic portion making contact with the earth, might be in contact with the crossed wire with serious results. To realize the full protection of the grounded wire, the grounding must be thoroughly done.

R. Arthur Joslyn.

Grounding 3-Wire, 110-220 Volt System, Ans. Ques. No. 520.

Editor Electrical Engineering:

With a 3-wire, 110-220 volt system that is not grounded, if one of the 220 volt wires is accidentally grounded, a person coming in contact with the other 220 volt wire when standing on the ground or with the body otherwise grounded would receive a 220 volt shock. On the other hand, when the neutral system of such a system is grounded and a person makes contact in the same way, a shock due to 110 volts only would be receive since the difference of potential between the outside wire and the neutral and between any outside wire and the ground is then 110 volts.

Further, if the 220 volt wire becomes grounded, a fuse will be blown in either the 220 volt side or the neutral or both and the trouble shown up.

W. W. Sockett.

Operation of Rotary Converters, Ans. Ques. No. 519.

Editor Electrical Engineering:

With increasing phase displacement irrespective of whether lagging or leading, the average as well as the maximum armature heating increases. This shows the necessity of keeping the power factor around unity at full load and overload. When this is applied to a case of phase control of voltage by a converter, it means that the shunt fields of the converter should be adjusted to give a considerable lagging current at no load so that the current comes into phase with the voltage at above full load. It is very objectionable to adjust the converter for minimum current at no load as occasionally done by inexperienced operators since such adjustment will give considerable leading current at full load and considerable unnecessary armature heating. The efficiency is directly affected by an increased heating effect.

To get unity power factor when the power factor indicator reads lag, raise the field excitation and to produce lagging current when the current leads, lower the field excitation of the shunt field. If the station has no power factor indicator, the only recourse is to adjust the field for minimum current at full load.

H. E. Weightman.

Data on Stranded Copper Cable, Ans. Ques. No. 521.

Editor Electrical Engineering:

The accompanying table gives data on stranded copper cables as made by the General Electric Company. The data however holds good for cables made by other companies and gives the necessary information for calculations when these cables are considered.

W. H. Hayes.

Data on Copper Cables—Concentric Lag.

Cir. Mils	Standard Strands			Flexible Strands			Omms per 1,000 ft.	Wt. per 1,000 ft.
	No. Wires	Diam. Wires in Mils	Diam. Cable in Mils	No. Wires	Diam. Wires Mils	Diam. Cable in Mils		
2,000,000	127	125.5	1631	169	108.8	1632	.00539	6180
1,900,000	127	122.3	1590	169	106.0	1590	.00568	5870
1,800,000	127	119.1	1548	169	103.2	1548	,00599	5560
1,700,000	127	115.7	1504	169	100.3	1504	.00634	5250
1,600,000	127	112.2	1459	169	97.3	1460	.00674	4940
1,500,000	91	128.4	1412	127	108.7	1413	.00719	4630
1,400,000	91	124.0	1364	127	105.0	1365	.00770	4320
1,300,000	91	119.5	1315	127	101.2	1315	,00830	4010
1,200,000	91	114.8	1263	127	92.2	1264	.00899	3710
1,100,000	91	109.9	1209	127	93.1	1210	.00981	3400
1,000,000	61	128.0	1152	91	104.8	1153	.0108	3090
950,000	61	124.0	1123	91	102.2	1124	.0114	2930
900,000	61	121.5	1093	91	99.4	1094	.0120	2780
850,000	61	118.0	1062	91	96.6	1063	.0127	2620
800,000	61	114.5	1031	91	93.8	1031	.0135	2470
750,000	61	110.9	998	91	90.8	999	.0144	2320
700,000	61	107.1	964	91	87.7	965	.0154	2160
650,000	61	103.7	929	91	84.5	930	.0166	2010
600,000	61	99.2	893	91	81.2	893	.0180	1850
550,000	61	95.0	855	91	77.7	855	.0196	1700
500,000	37	116.2	814	61	90.5	815	.0216	1540
450,000	37	110.3	772	61	85.9	773	.0240	1390
400,000	37	104.0	728	61	81.0	729	.0270	1240
350,000	37	97.3	681	61	75.7	682	.0308	1080
300,000	37	90.0	630	61	70.1	631	.0360	926
250,000	37	82.2	575	61	64.0	576	.0431	772
0,000	19	105.5	528	37	75.6	533	.0509	653
000	19	94.0	470	37	67.3	471	.0642	518
00	19	83.7	418	37	60.0	420	.0811	411
0	19	74.5	373	37	53.4	374	.102	326
1	19	66.4	332	37	47.6	333	.129	258
2	7	97.4	292	19	59.1	296	.162	205
3	7	86.7	260	19	52.6	263	.205	163
4	7	77.2	232	19	46.9	234	.259	129
5	7	68.8	206	19	41.7	209	.326	102
6	7	61.2	184	19	37.2	186	.410	81
7	7	54.5	164	19	33.1	166	.519	64.3
8	7	48.6	146	19	29.5	147	.654	51.0

Voltage Between Wires and Ground. Ans. Ques. No. 526.

Editor Electrical Engineering:

In order to demonstrate the voltage and current relations in a Y winding, let us go back to the wave form of the circuit. The voltage is assumed to be a sine wave as shown in Fig. 1, wherein the three phases are identical in form but are displaced 120 degrees from each other. This condition is created in the generator by placing the three windings 120 electrical degrees apart. In conventional form, the circuit may be represented as in Fig. 2, where one end of each of the three windings (AO, BO, CO) is brought to a common terminal O, known as the neutral point. The line wires are brought out from the outer ends A, B and C.

Referring again to Fig. 1 it can be proved mathematically, or graphically (by simply adding the ordinates, plus and minus, of the three voltage curves at any instant) that the algebraic sum of the voltage is always equal to zero. Take any time instant as VW. For the sake of convenience we may assume that the current is going out to the line through phases I and III (above the axis) and returning

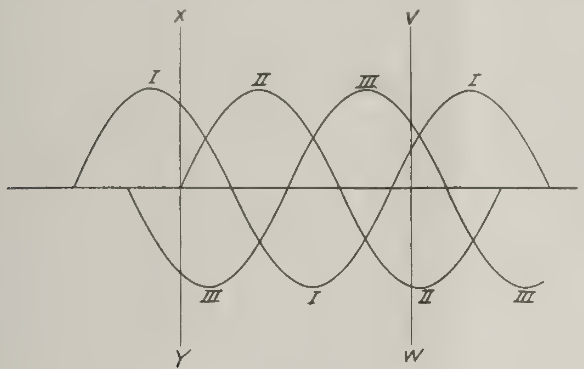


FIG. 1. SINE WAVE.

from the line through phase II (below the axis). At XY phase II is momentarily equal to zero and all the current is going out through phase I and returning through phase III. This is a convenient point at which to find the voltage and current relations, so a vector diagram is shown in Fig. 3. *e1, e11, e111* represent the three phase voltages, equal in length but 120 degrees apart. At the particular instant under consideration, *e11* =.o, so the resultant of *e1* and *e111* = E, the line voltage. We already noticed that *e111* was minus in sign, (i.e., acting towards the neutral point), hence before we can construct our parallelogram of forces, we must transfer it to the position OD, shown in dotted lines. The diagonal of the parallelogram AODF, constructed on OA and OD as sides, will now give the true value of the

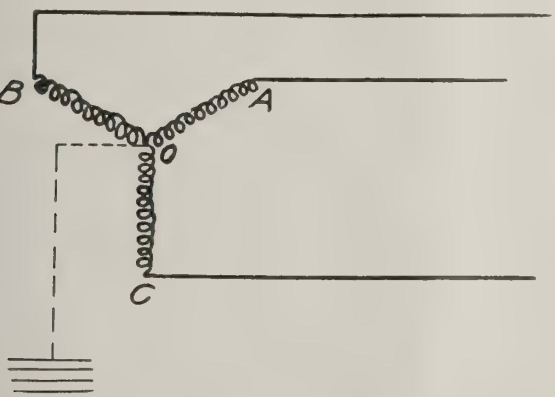


FIG. 2. THREE WINDINGS 120 ELECTRICAL DEGREES APART.

line voltage E. This is shown as OF. The angle AOF is evidently 30 degrees, hence by trigonometry the line OG = *e1* .cos 30 = .866 *e1*, and the resultant voltage E = 2OG = 1.73 *e1*. An identical vector diagram can be drawn for the current waves. It is obvious that at the instant when phase II is zero there is a simple series circuit from the line, through the winding BO, then through the winding OA and finally back to the line. Hence the current is the same throughout and I = i.

These formulas were derived from instantaneous values of voltage and current. But if the instantaneous line voltage is $\sqrt{3}$ times the instantaneous phase voltage, then the average line voltage will be equal to $\sqrt{3}$ times the average voltage. Similarly the average line current is equal to the average phase current.

From these we may derive the power developed in the circuit. If the current and voltage are in phase W = 1.73 EI. Since this condition rarely occurs in practice, we must multiply by the cosine of the angle between current and voltage, in other words by the power factor. Hence W = $\sqrt{3}$ EI Cos 0.

Now the voltage from one line wire to the ground is evidently equal to one of the phase voltages, as OA Fig. 3. Its value will therefore be equal to 60,000 ÷ 1.73 = 34,680.

It was shown in the first part of this answer that the algebraic sum of all the waves was always zero. Hence when

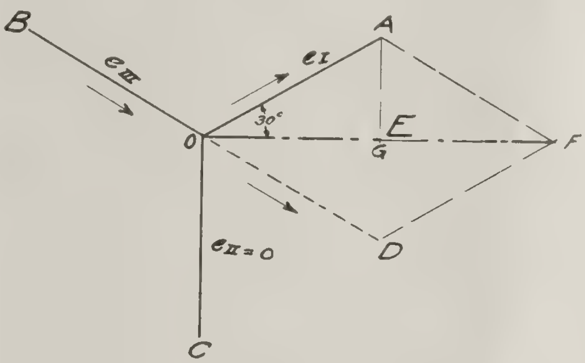


FIG. 3. VECTOR DIAGRAM.

the loads in the phases are balanced, there is no tendency for current to flow through the neutral wire and the voltage between one wire and the ground will be the same whether or not the neutral is grounded. If however, the load is unbalanced, equalizing currents flow through the neutral to ground if a means is provided. If not, the waves in the three phases will be considerably distorted, and the voltage between a line wire and the ground will depend on the amount of distortion. Its value can be determined graphically by vector diagrams, but in no good actual installation should it differ from the balanced condition more than 10 per cent.

V. A. Clarke.

Effect on Motor of Crossing Wires on 3-Phase Circuit. Ans. Ques. No. 541.

Editor Electrical Engineering:

The only effect of reversing, or "crossing" the phases or wires, of a three phase circuit is to make the motor run in the opposite direction, and will not in the least effect the operation of the motor.

The nature of the question makes it appear that this motor is running very hot, but whether it actually is or not should be determined by the thermometer.

The bearings should not show a temperature of more than 170 degrees Fahrenheit and the temperature of the windings should not be over 160 degrees Fahrenheit for safe operation.

These figures represent what is considered average good practice and are not intended to be absolutely accurate.

Generally, there are three causes of overheating of motors in oil mills, *viz.*:—Overload, poor circulation of air around the motor and choking up of the ventilating ducts in the motor by flying particles of lint, meal, dust, etc.

If the circulation of air is reasonably good around the motor, and the motor is fairly clean, then it is more than

likely that the motor is overloaded, provided that temperature tests show it to be excessively hot. The best way to determine whether it is overloaded or not is to have the local power company check the motor performance with an indicating wattmeter.

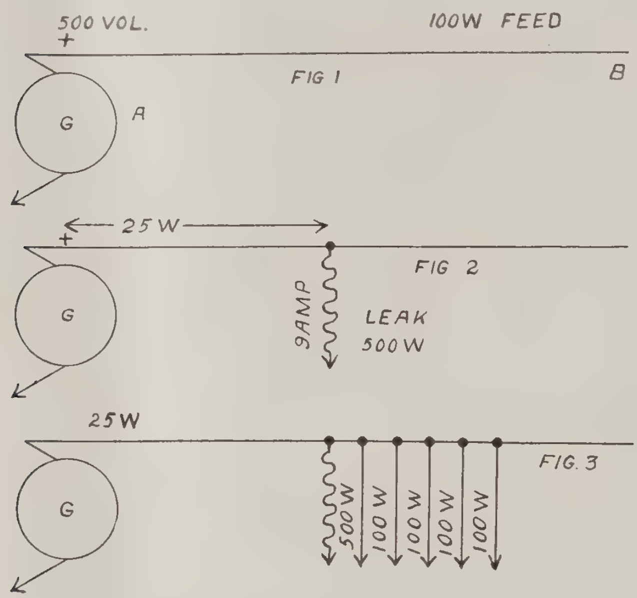
The accuracy of registration of the wattmeter will not be affected by reversing the service wires.

C. H. Broward.

Action of Partial Ground. Ans. Ques. No. 513.

Editor Electrical Engineering:

To try to explain the principle of derived circuit I have assumed a problem that will answer C. A. H.



Figs. 1-2-3, Diagrams of Partial Grounds.

If the feeder were grounded at B, there would be 5 amperes thereon, 500 ÷ 100 = 5.

In Fig. 2, we have sustained, 25 ohms from the generator, a leak of 500 watts. We now have flowing between the generator and ground on leak 500 ÷ 525 = .9 amperes.

In Fig. 3 we have five attachments of 100 ohms each in multiple, or in other words, we have added a load. To simplify the calculation it is assumed that the resistance of the feeder between the leak and the load assumed be neglible. According to the law of joint resistance the resistance of the five drops of 100 watts will be 100 ÷ 5 = 20. But we must take into consideration the 500 watts leak also. Therefore 500 × 20 ÷ 500 + 20 = 20 ohms. The load and leak consummate 20 ohms, and as there are 25 ohms from the leak to the source of current, we have a total of 45 ohms; 500 volts. The total current will be 500 ÷ 45 = 11 + amperes. As the drop between the source of current and the leak must be first considered, we have C × R or 25 × 11 = 275 volts drop. This gives us 225 volts to supply current to the leak and load. This current will divide in proportion to E ÷ R = C. Therefore the leak will obtain 225 ÷ 500 = .4 + amperes, or less current since the load was added. Each of the 100 ohm drops will obtain 225 ÷ 100 = 2.2 + amperes. If the load were made such that the five added drops were of 1,000 watts each, the leak remaining one of 500 watts, we would obtain .9 amperes in the leak, the same as shown in Fig. 2. The only chance to increase the current as shown in the leak is by its own resistance growing smaller due to current action, etc.

J. B. Dillon.

Data on Stranded Cables. Ans. Ques. No. 521.

Editor Electrical Engineering:

The following table gives data asked for in question No. 521:

Size Wire or Cable B. & S. Ga.	No. of Wires in Strand	Dia. of Individual Wires (Mls.)	Actual Cross-Sect. C. M.	Dia. of Bare Cable in Mils.	Approx. Lbs. per 1,000 feet copper.	Std. Length. Feet. Braid.	Std. Length. Lead Covered. Feet.
14	7	24.3	4,133	72.9	13		
12	7	30.6	6,555	91.8	20		
10	7	38.6	10,430	115.8	32		
8	7	48.5	16,466	145.5	51		
6	7	61.3	26,304	183.9	81	1,500	2,000
5	7	68.8	33,134	206.4	103	1,500	2,000
4	7	77.3	41,827	231.9	129	1,500	2,000
3	7	86.8	52,740	260.4	164	1,500	2,000
2	7	97.4	66,407	292.2	206	1,500	2,000
1	19	66.4	83,770	332.0	259	1,500	2,000
0	19	74.6	105,738	375.0	328	2,000	2,000
00	19	83.8	133,426	419.0	414	2,000	2,000
000	19	94.0	167,884	470.0	520	2,000	2,000
0 000	19	105.6	211,876	528.0	658	2,000	2,000
250 000	37	82.3	250,612	575.4	775	2,000	
300 000	37	90.6	303,709	634.2	943	2,000	
350 000	37	97.4	351,010	681.8	1,087	1,750	
400 000	37	104.0	400,198	728.0	1,242	1,500	
450 000	37	111.0	455,877	777.0	1,415	1,250	
500 000	61	90.6	500,710	815.4	1,554	1,250	1,250
550 000	61	95.0	550,525	855.0	1,709	1,100	
600 000	61	99.2	600 279	892.8	1,864	1,000	
650 000	61	103.3	650,924	929.7	2,020	900	
700 000	61	107.2	701,002	964.8	2.177	900	
750 000	61	111.0	751,581	999.0	2,333	850	
800 000	61	114.6	801,123	1,031.4	2,487	800	
900 000	61	121.6	901,980	1,094.4	2,813	750	
1 000 000	61	128.1	1,000,986	1,152.9	3,110	700	Same as Braided Wire
1 250 000	91	117.3	1,252,095	1,290.3	3,888	600	
1 500 000	91	128.4	1,500,276	1,412.4	4,660	500	
1 750 000	127	117.3	1,747,430	1,526.2	5.435	450	
2 000 000	127	125.5	2.000,282	1,631.5	6,212	400	

H. E. Weightman.

Breakdown Voltage of Insulating Material. Ans. Ques. No. 514.

Editor Electrical Engineering:

Our testing laboratory has done considerable testing of materials for electric breakdown. We formerly had two 110/13,200 volt transformers, which could be arranged in various combinations to obtain voltages up to about 30,000. This voltage was both regulated and measured in the primary side and breakdown could only be determined by visual and sound methods. This outfit was cumbersome and open to considerable error.

One of the transformer companies later designed a testing set consisting of a 110/52,000 volt transformer mounted on rollers and furnished with a table top upon which is mounted a voltmeter and the high tension terminals. This outfit is composite and may be connected to any convenient lamp socket and also rolled to one side when unused. The voltage is regulated by a carbon rheostat through a handwheel and shaft and the whole outfit is selfcontained.

A circuit breaker is mounted in front with the switch, so that when breakdown occurs, the breaker trips out. Leakage is determined by hissing sounds to which one must become accustomed.

For testing materials, as matting, we have two square pieces of wood to which are attached circular brass plates of 6 inches diameter. The material to be tested is placed

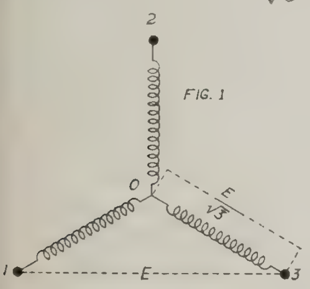
in between the blocks and a weight of approximately fifty pounds placed on the upper block so as to always maintain the same pressure. The voltage is then applied. Transil oil is tested by pouring a small quantity into a cup shaped vessel having terminals diametrically opposite each other and about an inch apart. An arc occurs between the terminals when the oil breaks down. H. A. Cozzens, Jr.

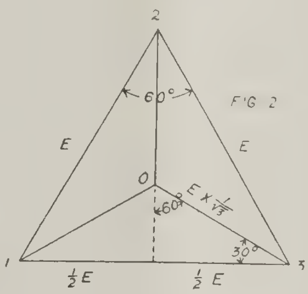
Voltage to Ground in Transmission Systems. Ans. Ques. No. 526.

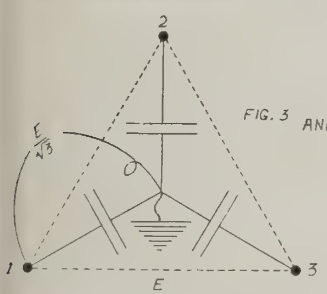
Editor Electrical Engineering:

If we have apparatus connected to a 3-phase supply as in Fig. 1, the E. M. F. between any two line wires will be the square root of 3, or 1.732 times the E. M. F. between any line wire and the junction O. This is evident from a consideration of Fig. 2, and the equations accompanying same.

From the above, we see that the voltage from any line wire to the theoretical neutral (whether that neutral be grounded or not) will be $\frac{1}{\sqrt{3}}$ times the line voltage.







$\text{SIN } 60° = .866$

$\frac{1}{2}E = .866 \times \text{QUAN. } O-3$

AND $E = 2 \times .866 \times O-3 = 1.732 \times O-3$

OR, $O-3 = \frac{E}{1.732} = \frac{E}{\sqrt{3}}$

FIGS. 1-2-3. VOLTAGE GROUND.

Now, if the apparatus in Fig. 1 be replaced with three condensers of equal capacity, as shown in Fig. 3; and the junction O grounded; it is evident that the voltage from any line wire to ground will be $\frac{1}{\sqrt{3}}$ times the line voltage.

This is precisely what we have in the case of a 3-phase transmission system; whether it be operating with grounded or ungrounded neutral. Each line wire acts as one plate of a condenser, with the earth as the other plate, and with the air and other insulation of the system as the dielectric. Thus the three condensers are in Y, having the earth, or ground, in common. Therefore, in any 3-phase system, either with grounded, or with ungrounded neutral, the voltage from any line wire to ground is the Y voltage of the system. Applying this to H. E. R.'s problem, the voltage to ground in a 60,000 system should be $\frac{60{,}000}{\sqrt{3}}$ or 3,464OE (Approx.). T. E. Tunison.

Selection of Insulators. Ans. Ques. No. 524.

Editor Electrical Engineering:

In selecting an insulator to withstand 22,000 volts and higher, the conditions under which they are to be used should be the first consideration, namely, temperature changes, rainy seasons, dry seasons, fogs, dust, altitude, electrical storms, voltages which they are to carry with mechanical load.

The main features would be dielectrical strength, their leakage surface, mechanical strength, homogeneousness (as some insulating bodies expand under heat and never contract to original state, causing cracks in time), one with lowest dielectric constant and low specific gravity.

The expansion and contraction of metal parts, and dielectric strength under mechanical load.

The apearance of static on insulator.

An insulator should be selected giving the greatest flashover with a dielectric strength two or three times greater.

Insulators should be free from internal strains, having uniform dielectric strength not varying more than 5 per cent, and should be capable of withstanding sudden temperature changes under all conditions.

The duration of test should have little effect upon the insulator. Fred M. Locke.

Electrical Prosperity Week.

Approval of the completed general plans for "Electrical Prosperity Week" was voted at the meeting of the Advisory Committee held in the offices of the Society for Electrical Development, Wednesday, May 19th. The committee members present renewed pledges of support and commented highly on the manner in which the campaign had been handled to date.

Within two weeks the Society will publish the proposed plans in a twenty-page booklet detailing what is expected to be accomplished by this great trade campaign. Over 50,000 copies of this booklet will be distributed to men of the industry. It is the intention of the campaign managers to try to get this booklet into the hands of every person interested.

While all of the details of the week have not been announced the campaign generally has been planned. From 10,000 billboards will go forth the message of cheer, optimism, good will and prosperity; in the newspapers and magazines the gospel of liberal thinking, right doing and solid business will be preached throughout the land; in store windows, on letter heads, postal cards, stamps, pennants, banners, electric signs and the hundred of ways of reaching the public and also the most obscure man in America. Electrical vehicle parades will be run in all the big cities of the country; the Lincoln Highway will blaze a trail from the Atlantic to the Pacific and White Ways will dominate the celebrations in the bigger cities. The great electric light plants will hold "house warmings" where the public will be told of the mysteries of generating electricity, its cost, the anxieties of the companies to keep on hand electrical supply to accommodate whole districts of the country.

ELECTRICAL ENGINEERING

(Formerly Southern Electrician.)
JOSEPH J. COSGROVE, Managing Editor.

Devoted to the generation, transmission and distribution of electrical energy for lighting, heating, power and traction. Correspondence suitable for the pages of ELECTRICAL ENGINEERING is solicited and paid for. Name and address of correspondents must be given,—not necessarily for publication.

Published monthly by the W. R. C. SMITH PUBLISHING CO., at Dalton, Ga.; editorial and advertising departments, Grant Building, Atlanta, Ga. Entered as second-class matter at the postoffice at Dalton, Ga. Subscription rate $1.00 for two years; Canada $1.00 a year; foreign $1.50 a year.

Vol. 47. JULY, 1915. No. 7

CONTENTS.

Many a salesman is a mine of useful information that courtesy and fair treatment will open up to your benefit.

Down in Savannah you may see cotton moved across great piers by "Electric Stevedores" equipped with hoists and cranes, carrying it directly into the holds of the steamers which bring it north. Two of these little Electrics would handle more cotton in one day than twenty freight handlers. At the Bush Docks in Brooklyn you can see the same cotton placed in cars by battery truck cranes, the cars first being "spotted" by the electric. It is taken out of the cars at the mill by the industrial trucks and moved to storage and then to the spinning room by them. Later the bobbins, dye tubs and beams are moved from mill to mill by small electric shop trucks.

Materials of Engineering Construction.

The materials of engineering construction will receive special attention in the proceedings and discussions of the International Engineering Congress to be held in San Francisco, September 20-25 next.

The field will be treated under 18 or more topics, covering: Timber resources; preserving methods; brick and clay products in general; life of concrete structures; aggregates for concrete; water proofing; volume changes in concrete; world's supply of iron; life of iron and steel structures; special steels; status of copper and world's supply; alloys; aluminum; testing of metals, of full sized members, and of structures.

Some 25 papers are expected for this volume, prepared by authors representing five different countries. The list of authors includes many of the most eminent names in this field of engineering work throughout the world.

Franchise Value as a Basis for Rate-Making.

A recent recommendation covering the valuation of franchises when considering the establishment of equitable rates for electric light and power, and gas utilities, made by the Board of Public Utility Commissioners of New Jersey, in a recent report to the Governor, is interesting on account of the common sense on which it is based. The board urges the amending of the public utility law to provide that, in the fixing of just and reasonable rates for service to be charged by a public utility, the franchise value of such utility should be considered and taken at a sum not in excess of the amount the board finds to have been legitimately expended in procuring it.

By the adoption of this plan, which is now in force with specific respect to the capitalization of franchises, asistance will be rendered the board in the rate-making investigations now under way with a number of properties. In this, the board sets forth that such valuations have been undertaken with a view of determining the reasonableness of the rates charged and of establishing new rates where such may be deemed advisable; such determination and fixation by the board necessarily involves valuations of the utilities' properties. This value fairly determined becomes the base on which the company shall be allowed a reasonable return, and governs the rate to the consumer.

In expressing its views upon the proper base for rate-making, the board says: "It is the opinion of the board that this base should not be merely the value of the company's physical property used in supplying service to the public. To hold this would require elimination from con-

sideration of expenditures legitimately incurred in developing the business of the utility to a state of efficiency commensurate with the requirements of the community in which it operates. The management of a utility which develops the utility's business in a thorough and efficient way, which seeks to obtain and is successful in getting and holding as its customers those who, except for the effort of the utility to make its service attractive would not take it, should not be penalized.

"Expenses reasonably incurred in this way, sometimes called 'going concern value,' sometimes 'development cost,' in the opinion of the board, should be considered in determining the base on which a return should be allowed. The utility furthermore should be allowed a return on expenses legitimately incurred in obtaining the franchise under which it operates."

The Light That Fails.

We are apt to think of the light that flickers, dims and goes out, as the light that fails, and overlook the very obvious fact that a light of too great intensity, the wrong color or coming from the wrong direction is an equal failure. It is interesting to note, therefore, the thought and study being given to the subject, and the valuable papers being presented at meetings of electrical societies on shop, street, store and residence lighting.

In the early days of the art of lighting with electricity, the prime consideration was to produce a strong, brilliant, light at the lowest possible cost. With the growth in perfection of the electric lamp, however, there came a time when intensity had to give way to other qualities, and a softer, more diffused light, came into demand. The strong glare of a high power lamp is trying if not actually painful to many eyes, and a flood of white light illuminating every nook and cranny of an interior might be effective from the standpoint of banishing darkness, but robs the room of that pleasing artistic effect wrought by the lights and shadows of a weaker and less diffused light.

Many fashionable restaurants owe their popularity not so much to their cuisine as to the effects produced by the use of lower-power table lamps which throw a soft pleasing light through pretty shades. In such surroundings, even the ugly look beautiful, the faces at the tables standing out in bold relief from the darkened background and giving a Rembrandtesque effect to the picture, suggestive of the old days of tallow candles.

It might not be stating the matter too strong to say that every type of building requires a quality and intensity of light peculiar to itself; and that every kind of room in a home needs a distribution of light different from the other rooms. In other words, when planning the illumination of a building, each room must be studied by itself with relation to its use, if the best results are to be obtained and the greatest degree of satisfaction given. In the art of illumination, some places require plenty of light at particular points with general illumination for the rest of the place; while in stores and other places where colors are to be matched will be needed a color of light which will show the fabrics in their natural colors.

To produce the various effects desired requires a variety of fittings and fixtures, and in the Industrial Section of next month's issue may be found types and designs of fixtures used in residence illumination. In the succeeding number we will follow up with types and designs of electric-light fixtures used for street, store and mill lighting, and the latest developments in illumination practice can there be seen.

The Engineering Foundation.

There was held recently the first regular meeting of the Engineering Foundation, at which Rules of Administration were adopted and the following officers elected: Chairman, Gano Dunn; Vice-Chairman, Edward D. Adams; Secretary, F. R. Hutton; Treasurer, Joseph Struthers. This is a professional engineering trust organized along the lines of the Cleveland, Carnegie, Rockefeller and Sage Foundations, by the United Engineering Society, representing jointly the national organizations of Electrical, Mining and Mechanical Engineers with the co-operation of the national organization of Civil Engineers, combining about 30,000 members.

The Engineering Foundation was made possible through the generosity of a distinguished engineer, Ambrose Swasey, of Cleveland, who made the initial gift of a quarter of a million dollars to be devoted to the benefit of mankind through fostering engineering research. The distinguished Board administering this trust consists of Mr. Edward D. Adams, Banker; Mr. Gano Dunn, President The J. G. White Engineering Corporation; Mr. Howard Elliott, President New York, New Haven & Hartford Railroad; Dr. Alexander C. Humphries, President Stevens, Institute of Technology; Dr. Charles Warren Hunt, Secretary American Society of Civil Engineers; Dr. A. R. Ledoux, Past-President American Institute of Mining Engineers; Dr. M. I. Pupin, Professor Electromechanics, Columbia University; Mr. Charles E. Scribner, Chief Engineer Western Electric Company; Mr. J. Waldo Smith, Chief Engineer Board of Water Supply, Gas & Electricity, City of New York; Mr. Jesse M. Smith, Past-President, American Society of Mechanical Engineers, and Mr. Benjamin B. Thayer, President Anaconda Copper Company.

The Board telegraphed Mr. Swasey greetings and appreciation of his generosity and pledged itself to carrying out his cherished aims.

Applications for the use of funds were received in large numbers and a Committee was appointed to consider them, consisting of Dr. A. R. Ledoux, Chairman; Mr. J. Waldo Smith, Dr. M. I. Pupin, and Dr. Alexander C. Humphreys. Most of the applications were in such form that they could not be considered and the Committee is preparing a schedule of requirements with which applications will have to comply.

The Engineering Foundation is the first of its kind devoted to engineering interests.

Concerning the Electrical Trade

News of Activity by Jobbers, Dealers, Contractors, Central Stations and Manufacturers.

Col. C. Robert Churchill, President and General Manager of the Electric Appliance Company, New Orleans, La.

Everybody knows him in New Orleans. That is, everybody worth while. He is equally well known throughout the South, for his activity in various lines brings him in contact with all business interests. And then, he is a "joiner." Not one of the mild, conservative, kind which belongs to only a dozen or two orders, but a great, big, broad, generous joiner that takes in everything from college clubs to Masonic fraternities.

Col. Robert Churchill.

Just to round out his time and put in a full day's work for fourteen years he was a member of the National Guard and other volunteer organizations, serving in every capacity from a private to captain of a cavalry organization, and subsequently being promoted to the position of Adjutant General.

The military career of Captain Churchill wound up with the rank of Lieutenant-Colonel, a rank which his services won.

Like most successful men, Colonel Churchill is more or less of a graduate of the school of hard knocks. Before becoming identified with the electrical industry, he devoted his energies altogether to the refining of sugar and the manufacture of machinery used in the sugar refining business. It was by accident he got into the electrical business. When he left college he had planned to follow the profession of industrial chemistry, but was tempted from his course by the more fascinating study of electricity.

He got his start about 17 or 18 years ago in New Orleans, working for the old Louisiana Electric Light and Power Company, where he had charge of the inside construction department. In those days the company did its own wiring and installing of meters, and the Colonel used to swear at—no, no, by—the meters. Now, however, it is the source of a great sorrow to him when he thinks of the marvelous tales of accuracy he used to tell about those old meters, and compares them with the improved meters of the present day. The Colonel has no hobby. That is, no particular hobby if you except everything, for everything is a hobby with him. His principal hobby is to get well ahead in the world and perhaps get a wife—But, no. That is not a hobby, it is an ambition! He is an enthusiastic fisherman and has been all of his life. His friends say that all you have to do is to get him started on tales about the fish he and his cronies caught the past Sunday for we very much regret to say he does fish on Sunday.

The Electric Appliance Company of which Colonel Churchill is the President has built up a splendid business in the South. Among the many lines which they handle and represent are the following:

Schedule Goods—Bryant Electric Co., Bridgeport, Conn.; Perkins Electric Switch Mfg. Co., Bridgeport, Conn.; Hart and Hegeman Mfg. Co., Hartford, Conn.

Meters—Sangamo Electric Company, Springfield, Ill.

Wire and Lamp Cord—Indiana Rubber and Insulated Wire Co., Jonesboro, Ind.; Phillips Insulated Wire Co., Pawtucket, R. I.

Fans—Emerson Electric Mfg. Co., St. Louis, Mo.; Colonial Fan and Motor Co., Warren, Ohio.

Switches—Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

Insulators—Hemingway Glass Company, Covington, Ky.

Fixtures—Luminous Unit Company, St. Louis, Mo.; A. Sechrist Mfg. Co., Denver, Col.

Incandescent Lamps—Packard Lamp Division, Warren, Ohio.

Transformers—Packard Electric Co., Warren, Ohio.

Motors—Wagner Electric Mfg. Co., St. Louis, Mo.

Ethics in Business.

It is a common statement that there is no sentiment in business. It is a case of dog eat dog, or to adopt the old common-law version, "let the purchaser beware."

That might have been good policy in the past, but it is not looked upon in that light today, and the Associated Advertising Clubs of the World which met in convention at Chicago June 20, has always thrown the weight of its influence against dishonest advertising and in favor of ethical standards in merchandising.

And the weight and influence of this powerful organization is not a matter to be lightly ignored as the records of attendance at the convention show. Mr. T. W. LeQuatte, President of the Associated Advertising Clubs of Iowa made reservations at the Sherman House for 1,000 of their followers. The Pilgrim Publicity Association of Boston followed with reservations for 200 members at the Congress Hotel, and the same number for the Advertising Men's League of New York; while the Poor Richard Club of Philadelphia engaged an entire floor at the LaSalle.

The Grand Rapids Advertisers' Club, true to its convictions that advertising pays, did the spectacular in chartering the "City of Grand Rapids" for $10,000 to take them to the convention, dock, and serve as their headquarters during their stay in the convention city.

That accounts for only a small portion of the Advertising Clubs of the United States, but the rest of them were on hand in such numbers and advocating principles worthy of the men who have the placing of orders for over $600,000,000 of advertising annually.

The size of the organization and the money the members spend would not be worthy of mention, however, if it were not for the principles they are formulating and the practice they are systematizing. They are in a sense business men or merchants, and must get all they possibly can for the money they spend. That is, every advertisement they pay for must have a definite and favorable result. If their advertisements are mixed in with others of a questionable nature, however, the results are bound to be lessened if not actually negative. Therefore they say, honesty and perfect honesty is one of the prime requisites of advertising, and have set out to make outcasts of those who would lie in print. How successful they have already been may be inferred from the facts that many publishers now guarantee their readers against dishonest advertisers, refusing those of questionable natures or shady reputations; and some states have laws dealing with advertising statements which are not based on facts.

The work of the Associated Advertising Clubs is worthy of hearty support. Honest advertising can not but benefit the manufacturer, the publisher and the public.

Control Apparatus—Rheostats, Motor Starters and Regulators

BY J. R. ROBERTS.

A rheostat is a resistance device or apparatus for use in an electric circuit. In practice it is a variable resistance introduced in a circuit to regulate the strength of the current. A familiar type of rheostat

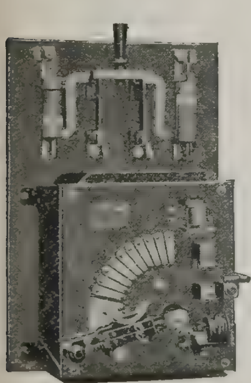


Fig. 1.

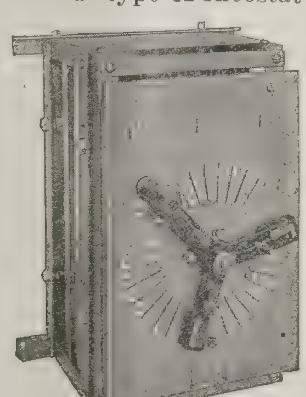


Fig. 2.

Fig. 1. Universal Starting Panel; Has Starting Rheostat, Main Line Knife Switch and Fuse.
Fig. 2. Speed Regulator for A. C. Polyphase Slip-ring Motors, Made by Cutler-Hammer Mfg. Co., Milwaukee, Wis.

is the starting box or starting rheostat used in connection with electric motors. When so used they not only regulate the strength of the current and consequently the speed of the motor, but the force is applied to the motor gradually and with increasing intensity so there is no shock or damage to the motor.

It is common knowledge, even to a boy, that if he wants to start a heavy boulder rolling down hill, or start in motion any stationary load, he will meet with the most success by applying the pressure of his body gradually, and increasing the push successively. If he were to dash himself against the rock in an effort to dislodge by the force of the blow, the shock of his impact would be absorbed by the rock without moving it, but he would not be undamaged himself. This knowledge is applied to all moving or movable objects, and they are started in motion gradually.

This same principle, then, of gradually increasing the force, is applied when starting an electric motor, and the appratus used for the purpose is the rheostat.

Rheostats are designed for a number of special purposes, and each type of rheostat takes its name from the work it performs or the purpose for which

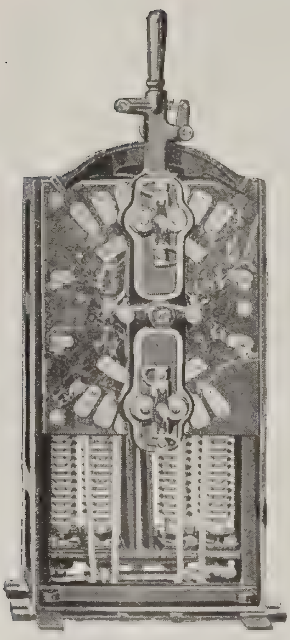


Fig. 3.

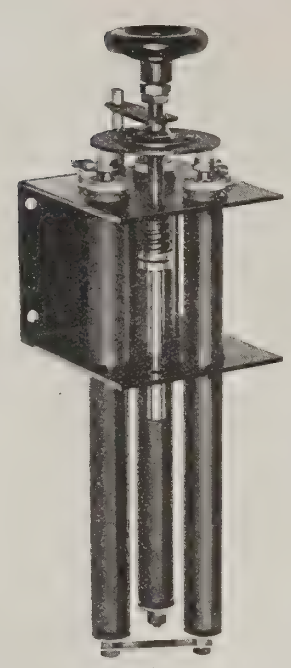


Fig. 4.

Fig. 3. Graphite Compression Type Resistance Crane and Mill Controller for D. C. Motors.
Fig. 4. Graphite Compression Type Resistance Controlling Rheostat for both D. C. and A. C. Motors.
Made by the Allen-Bradley Company, Milwaukee, Wis.

it was designed. For instance, motor starting rheostats are used to start, stop, accelerate to full speed, and sometimes they are used to regulate or control the speed of the motors. Battery-charging rheostats, on the other hand as the name would imply, are used for charging storage batteries.

The field for battery-charging rheostats, it is interesting to know, is ever growing wider owing to the number of garages now making a practice of charging batteries for ignition purposes on motor

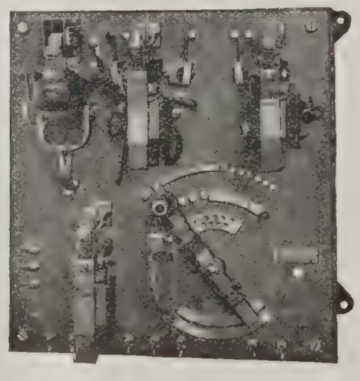


Fig. 5.

Fig. 5. Direct Current Predetermined Speed Controller for Flat-bed Printing Press.

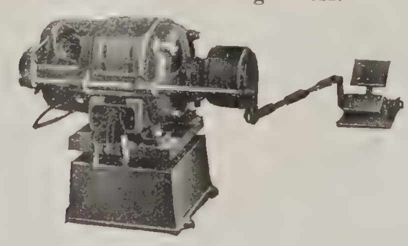


Fig. 6.

Fig. 6. Single-Phase Motor with Foot Control, Mounted on Spring Base for Friction Drive to Flywheel.
Made by Sprague Electric Works, New York City.

Fig. 7.

vehicles. In some sections of the country, too, where electrically operated vehicles are numerous, garages as well as electric power stations are being equipped to recharge the operating batteries. This increasing and improving the electric service for motor cars is having the natural effect in those sections of increasing the number of electric cars used, with the consequent gradual upbuilding of the electrical industry.

There are two kinds of battery-charging rheostats in use. Those for charging lead cells, or the ordinary type of battery, and special rheostats for charging Edison cells. Rheostats for charging Edison cells must have greater capacities than those used for charging lead-plate batteries.

As a rule battery-charging rheostats are designed for use where the voltage is 115 or less. For use on lines having higher voltages, special rheostats are necessary.

Besides the rheostats already mentioned, there are load and meter testing rheostats; photometer rheostats; water rheostats, and finally field rheostats. Generally speaking, those rheostats which are not designed for a particular purpose or class of service,

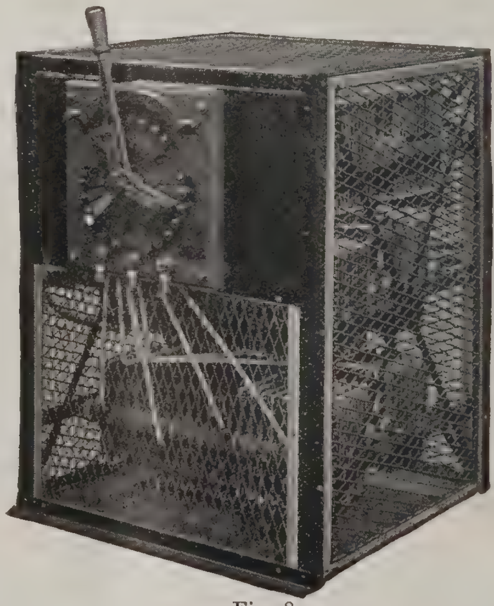


Fig. 8.

Fig. 7. Potential Starter for Squirrel Cage Motors.
Fig. 8. Resistance Controller for Any Motor.
Made by the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

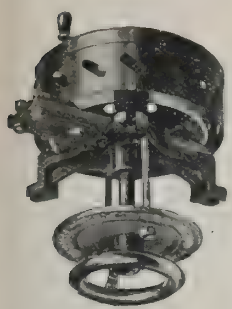


Fig. 9.

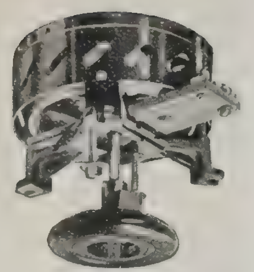


Fig. 10.

Figs. 9 and 10. National Rheostats.
Made by National Electric Controller Company, Chicago, Ill.

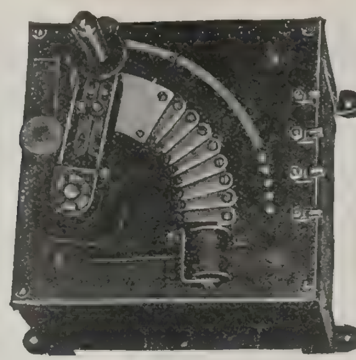


Fig. 13.

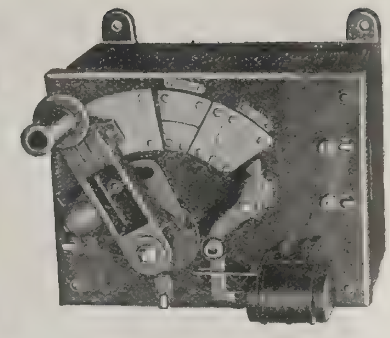


Fig. 14.

Figs. 13-14-15. Illustrations of Control Apparatus made by the General Electric Company, Schenectady, N. Y.

are known as field rheostats, for the reason that they operate to change the strength of the field current.

Water rheostats are in a class by themselves, and are of the "home-made" variety. They are used for absorbing large outputs where great accuracy is not essential. A water rheostat can be made out of an ordinary oil barrel. An iron plate placed at the bottom of the barrel serves as one electrode to which is connected a well-insulated wire. The barrel is then filled with water, and the other electrode, a similar iron plate, is connected to a copper wire and attached by means of a rope to a counterweight so that it can be suspended in the liquid in the barrel and can be moved up or down at will to vary the resistance.

The liquid in the barrel may simply be water, or when greater conductivity is desired, salt, salammoniac, or sal-soda may be added to the water. The salts are preferably added in the form of a solution, as the amount added can then be more easily controlled.

Ordinarily a barrel rheostat can carry a current of from 90 to 100 amperes without excessive boiling.

Rheostats are made for both direct current circuits and alternating current circuits; and field rheostats are made with capacities ranging from 75 volts up to 750 volts.

Commercial types of rheostats are shown in the accompanying illustrations. They are known by various names according to their types, as for instance, grid and plate rheostats made up of grids or plates containing the resistance; and tube and unit rheostats in which the resistance material is wound around a core.

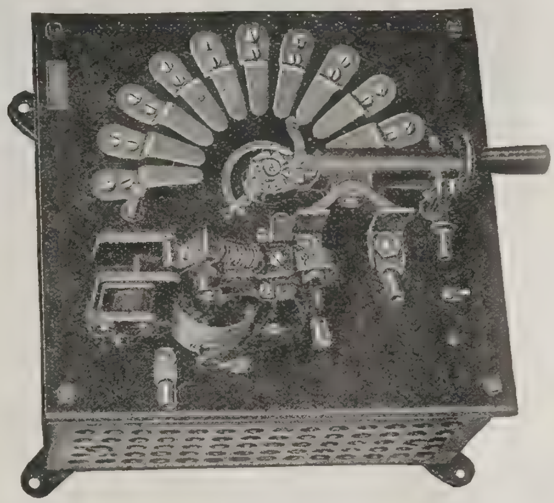


Fig. 15.

In purchasing or specifying a rheostat, it is well to select a type and make suitable for the work it will have to perform. There is a wide variation in the characteristics of the various types and makes.

Fig. 11.

Fig. 12.

Fig. 11. Magnet Switch without Blowout, for Direct Current.
Fig. 12. Magnet Switch with Blowout, for Direct Current.
Made by Automatic Switch Co., New York City.

Fig. 16.

Fig. 16. Field Rheostat. Fig. 17. Double Lever Type Speed Regulator. Made by the Union Electric Mfg. Co., Milwaukee, Wis.

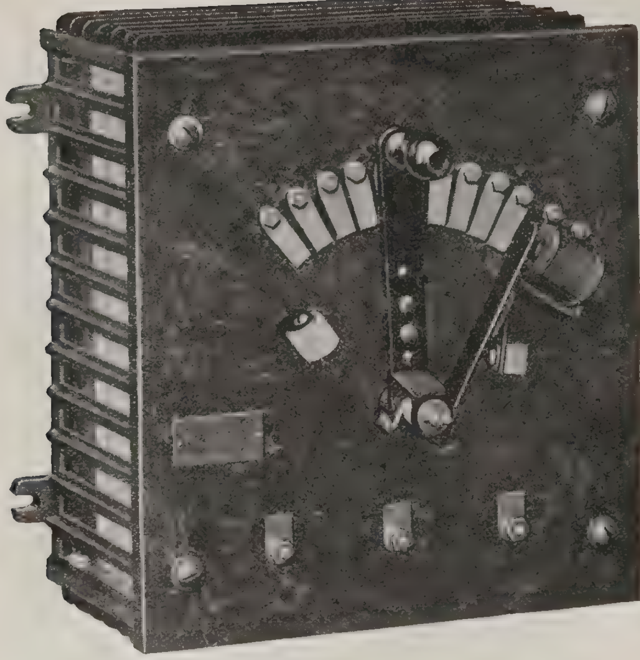


Fig. 17.

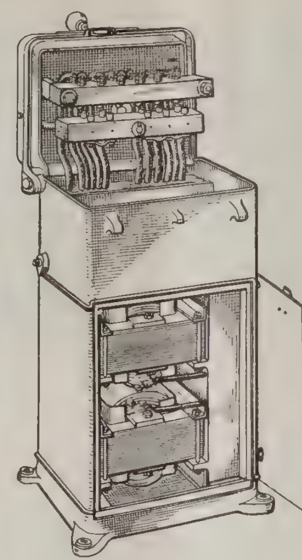


Fig. 20.

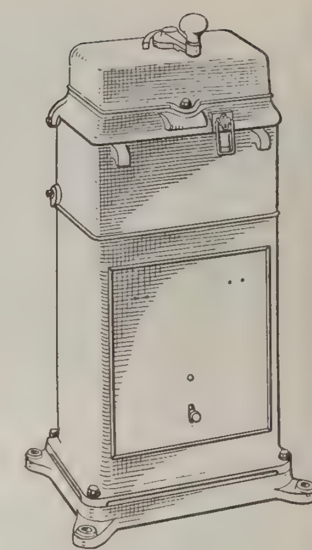


Fig. 21.

Figs. 20 and 21. Control Apparatus.
Made by Crocker-Wheeler Company, Ampere, N. J.

so that there will be no difficulty in getting a rheostat suitable for almost any conceivable duty. They are made for high voltage and for low voltage; with high current-carrying capacities and with low current-carrying capacities; with high resistance and with low resistance; and if the particular use for which the rheostat is intended is specified, an apparatus suitable for that purpose can be supplied.

There are three different classes of rheostats made, the classification depending upon the materials of which they are made and the manner in which they are assembled. Rheostats of one class are made by placing in a suitable box spools wound and connected in series with german silver wire or other alloys of low conductivity and small temperature coefficient. Such rheostats as a rule have rather a small current-carrying capacity, and this particular feature which might be desirable in some cases and

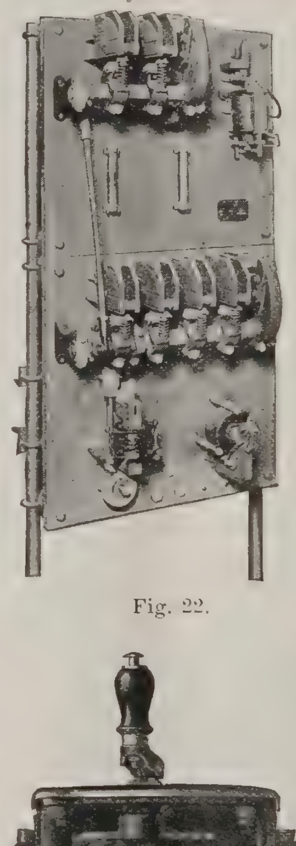


Fig. 22.

Fig. 23.

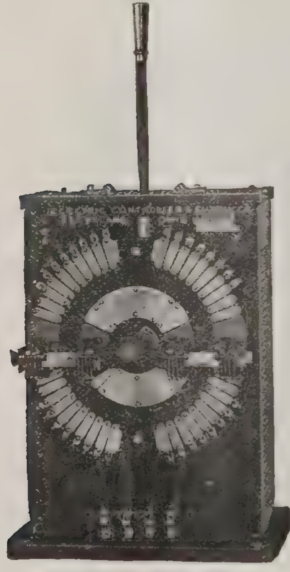


Fig. 18.

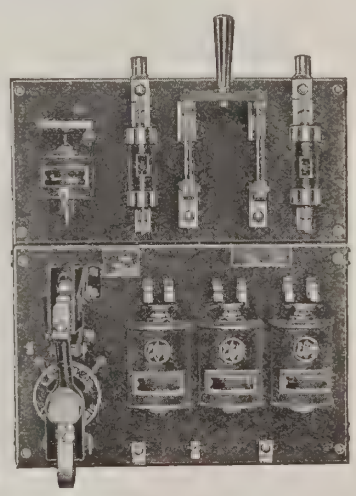


Fig. 19.

Fig. 18. Dinky Controller. Fig. 19. Automatic Starter.
Made by the Electric Controller & Mfg. Co., Cleveland, Ohio.

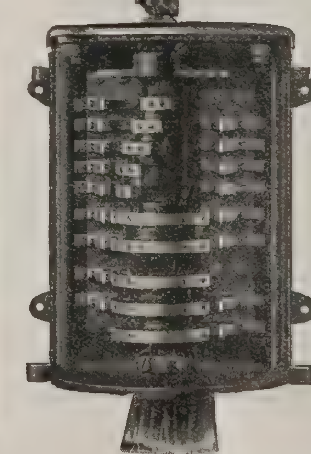


Fig. 24.

Fig. 25.

Figs. 22, 23, 24 and 25. Control Apparatus made by the Westinghouse Electric and Mfg. Company, Pittsburgh, Pa.

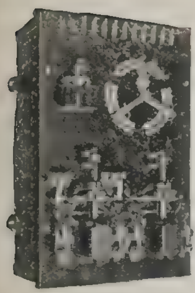


Fig. 26. Fig. 27.

Fig. 26. Variable speed alternating current controller for machinery requiring a wide range of speed adjustment and full starting torque, regardless of pre-set running speed.
Fig. 27. Starter designed for use on all classes of work. The controller has a remote control magnetic switch for handling the main current.
Made by the Monitor Controller Company, 111 S. Gay St., Baltimore, Md.

undesirable in others it might be well to keep in mind when making a selection for any particular purpose.

The second class of rheostats uses carbon plates as a resistance. The plates are mounted side by

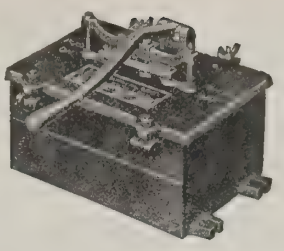


Fig. 28.

Fig. 28. Induction motor starter for induction motors up to 7½ horsepower, or those motors which may be started by switching them directly on to the full voltage service.
Made by the Detroit Fuse & Mfg. Co., 1409 Rivard St., Detroit, Michigan.

side and the resistance is changed by varying the pressure between the plates. The resistance of this type of rheostat is, as a rule, rather low but its current-carrying capacity is quite large, two features which will recommend it for some classes of work. Another feature of carbon rheostats which will be well to keep in mind is that they operate very satisfactorily in low voltage circuits, and the variations in their resistance can be made very gradual.

The third class of rheostats is the water rheostat already described, one of the chief characteristics of which is the high resistances.

New Apparatus and Appliances

3-Unit Boron-Aluminum-Silicate Insulator With Dielectric Strength of 225,000 Volts per Unit.

Insulation Tests.

Memorandum of Tests Conducted on Boron Silicate Insulators Manufactured by Fred M. Locke, Victor, N. Y.

1st:—Simultaneous Mechanical Electrical Tests.—Each of these units was subjected to an interesting mechanical strain (pull) starting at 6,000 pounds and ascending in steps of 1,000 or 2,000 pounds. At the same time these units were subjected to 60,000 volts potential. This potential was considerably below the dry flashover but was the maximum that we had available at that time. None of these units punctured during these tests.

Unit No. 1 stood a mechanical electrical test up to 12,000 pounds without any sign of distress.

Unit No. 2 stood a mechanical electrical test up to 11,000 pounds. Just after 12,000 pounds had been applied the unit pulled apart, shearing the glass evenly in a cleavaged plane at about 60 degrees from the vertical at a point about one-half inch from the bottom of the cap.

Unit No. 3 stood a mechanical electrical test up to and including 12,000 pounds.

Unit No. 4 tested out satisfactorily at 11,000 pounds, but upon the application of 12,000 pounds the eye pulled out of the cement of insulator, but unit was still good electrically.

2nd:—Electrical Test.—The three remaining units were shipped to Solvay and tested as follows:

Dry flashover of one disc—115,000 volts.

Two glass discs in series—198,000 volts.

3rd:—Test Under Oil.—All the glass insulators were tested under oil without puncture. The maximum voltage obtainable due to leakage and flashing around the insulator or to the containing vessel was 170,000 volts. None of these units could be punctured at this voltage.

White Cross Electric Iron De Luxe.

The White Cross Electric Iron is a new addition to the White Cross Line, manufactured by the Lindstrom, Smith Co., of Chicago. Special care has been taken in the manufacture of this iron, and it is constructed so that practically all of the heat radiates to the point and edges where it is most needed. It heats very quickly and holds the heat a

long time. Handle always remains cool. Its weight, shape, balance and design make it suitable for general household and laundry work. It will iron the most delicate fabric to heavy woolen goods. It is pointed to reach the most obscure places in ironing. No stand is necessary, as the iron can be tipped back. The iron is heavily nickel plated and polished. Weight 6 pounds.

Pyrene Motorizes Sales Department.

The Pyrene Manufacturing Company, which make one of the most valuable automobile accessories, the Pyrene Fire Extinguisher, is reciprocating with the automobile trade by motorizing its sales department.

The Pyrene Company recently bought six Ford automobiles, which are in use in six different branch offices, and which will be used entirely by salesmen, and not for deliveries. This company has used trucks in delivering for some time.

The installation of these six Ford automobiles is only the beginning of a general use of automobiles for its salesmen, and it is expected that within a short time the company will have a great many in use.

Needless to say, each automobile will be equipped with a Pyrene Fire Extinguisher.

White Cross Electric Examination and Vest Pocket Lamp.

This lamp is indispensable for doctors, dentists and nurses. Can be carried in vest pocket or in hand bag. It is no larger than a large pencil. The switch of the flashlight is used as a clamp or to prevent it from slipping out of the pocket.

A Small Compact Electric Examination and Vest Pocket Flashlight.

The battery will give continuous light for a long time and at least one thousand flashes.

The tongue depressor can be easily removed and carried in the instrument case. It can be slipped on the lamp in a moment.

This is not only a novelty, but a practical powerful flashlight and examination lamp. It is 5 inches long and ⅝ inch in diameter. Case and tongue depressor are heavily nickel plated and highly polished.

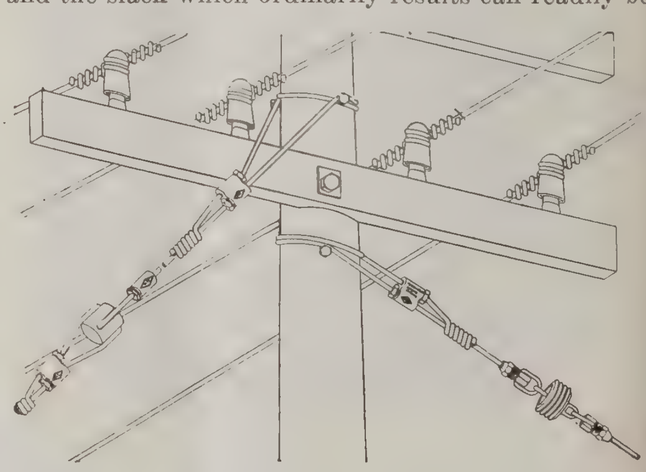
New bulb and batteries can be purchased at any store handling flashlights. Manufactured by Lindstrom Smith Co., 1100-1110 S. Wabash Ave., Chicago, Ill.

Use of Silica-Graphite Paint.

A practice that is fast gaining adoption in progressive power plants is the use of paint for the inner surface of steam boiler drums. The paint is said to afford protection against pitting. Silica-graphite paint is used for this purpose and for a number of years the manufacturers of this paint have coated the steam drums of five B. & W. boilers developing 1800 Hp. and as a result the drums are in almost perfect condition. Another instance, in a plant equipped with B. &. W. boilers developing 8400 Hp., the interiors of the drums were scalded, painted both above and below the water line and allowed 48 hours to thoroughly dry. This treatment was repeated every ten months and not only did it stop pitting but where it had previously taken six men seven days to clean the drums of one boiler, two men now clean them in a day. This latter experience is quoted from a letter of the Chief Engineer of the New York Life Insurance Company, in April issue of Graphite. Silica-Graphite paint is made by the Joseph Dixon Crucible Co., Jersey City, N. J.

Fargo's Steel Cable Grip.

The Fargo Manufacturing Company of Poughkeepsie, New York, is putting on the market a new Cable Grip for which they claim several improvements. It is used on guy wires supporting poles, and the slack which ordinarily results can readily be



taken up without trouble. The grip is put together without the use of set screws or bolts, so there are none to work loose, a fruitful cause of trouble in some cases.

The clamp is very strong, compact, and is said to prevent any undue bending or cutting of the strands.

The Fargo Manufacturing Company will be glad to send descriptive catalogues of their various connection devices to those who are interested.

Water-Tight Marine Lighting Fixtures.

The Raymond Electric and Mfg. Co., Detroit, Mich., is putting out a complete line of water-tight electric light fixtures and fittings for use on shipboard, in mines, or wherever a lamp requires protection against breakage likely from sprays of water or other fluids; and for insurance requirements where lights are in places exposed to explosive gases or combustible materials.

They will be glad to send a copy of their catalog showing various types of drop fixtures; ceiling lights; cargo reflectors; compass light shades; water-tight globes; steam-tight fixtures and bulkhead fixture.

Electric Ranges.

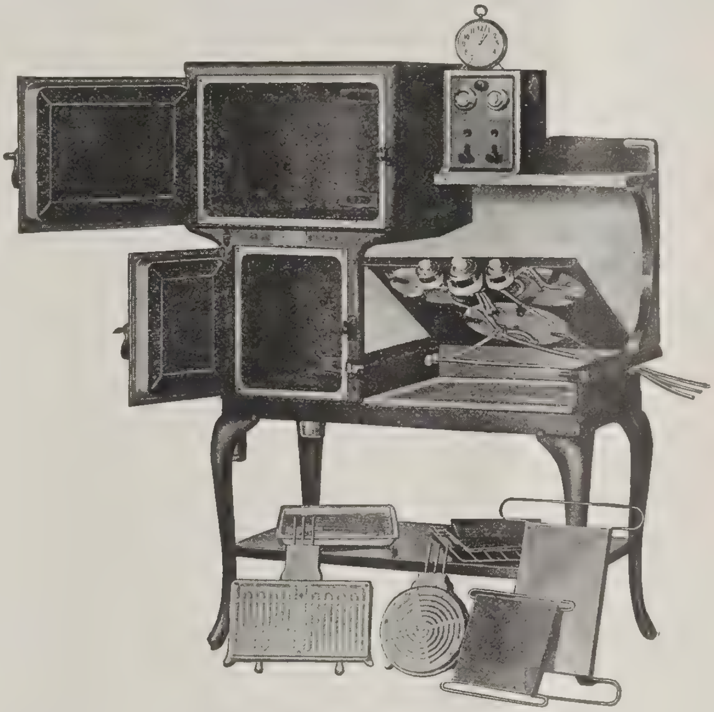
"Ready by the clock" is the slogan adopted by the Westinghouse Electric & Mfg. Company for its new line of electric ranges, signifying that meals can be cooked on these ranges to be ready at a certain time.

The ovens of these ranges have automatic temperature and time control. The thermometers in the oven doors can be set for the desired temperatur and the clock switch set for the time it is desired to begin cooking. At the time set the circuit is closed and the ovens begin to heat. As each oven reaches the desired temperature the current is automatically turned off and the range continues to cook as a fireless cooker.

By means of the automatic control, which is claimed as an exclusive feature, it is possible for the housewife to leave the range to itself after the food is prepared, and go calling or shopping with the assurance that the meal will be properly cooked and hot at the desired time and with a minimum consumption of current. This arrangement also makes it possible to prepare breakfast before retiring at night and have hot, deliciously prepared cereals and coffee ready at breakfast time.

A record obtained from 24 families over a period of six months shows an average consumption of about 100 Kw. hours per month.

Considering the saving made possible in servant hire and in the more economical use of food with these ranges, they make a very attractive proposition to the householder. From the standpoint of the central station they produce an increase in load at an



hour that is generally earlier than the evening lighting peak.

The ranges are made in two sizes and either with plain or nickel finish trim of both the automatic and non-automatic types and are fully described and illustrated in Section DS 535 issued by the Westinghouse Electric & Manufacturing Company.

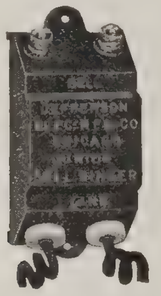
Bell Ringing Transformer.

Percolators, curling irons, chafing dishes, etc., are not on the circuit more than a few hours at a time, and whether they are efficiently designed or not makes little or no difference to the consumer as far as his bill is concerned.

But with a bell ringing transformer it is another matter. A bell ringer is connected on the circuit continuously, so that there is a certain amount of current flowing through it at all times. A transformer that is not properly designed will consume current continuously. Even if this loss amounts to only two or three watts, it will run up to several dollars a year in maintenance.

The contractor or electrician that installs any kind of a bell ringer simply because it is a bell ringer is taking chances. The consumer will sooner or later

find out whether or not the transformer is consuming power. Before adopting a transformer as a standard, take the trouble to test it. It only means a few minutes and you are protecting your customers.



The illustration shows the Jefferson Bell Ringing Transformer. The core-loss in this transformer is said to be less than three-fourths of a watt. This is not sufficient power to register on the average wattmeter. It is claimed that owing to its efficiency, will take care of a greater amount of signal work than the average small transformer. It has sufficient capacity to operate all standard types of door openers.

This transformer, as well as a complete line of Bell Ringing and Toy Transformers, is manufactured by the Jefferson Electric Mfg. Co., 847-851 W. Harrison St., Chicago, Illinois.

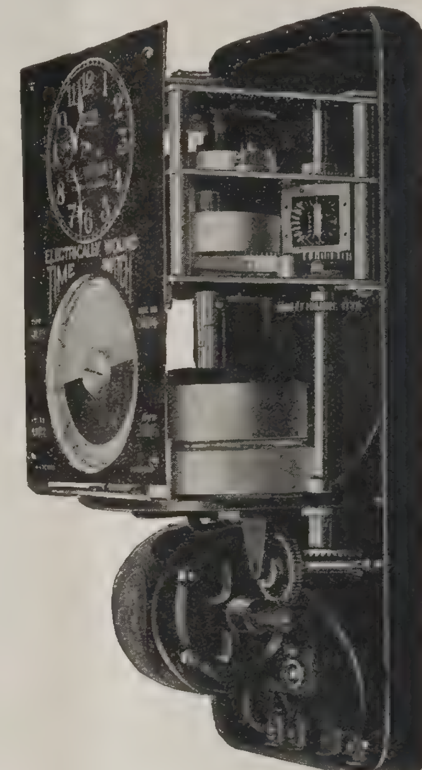
Wall Receptacle for Concealed Wires.

The Bryant Electric Company of Bridgeport. Conn., have brought out a new ceiling and wall receptacle for concealed wiring, designated as their catalog No. 4102. This is designed especially for a 3¼-inch outlet box, although it can be used for ordinary coiling work because of its perfectly flat back. This device measures only 3⅝ inches outside by 1½ inch deep. Holes for supporting screws are spaced on 2¾-inch centers. Binding screws are provided to which "loop" wires may be readily attached. Catalog 4103 similar in external appearance and dimensions, is supplied with two wires or "pig tails" of suitable length to facilitate ready installation.

Minerallac, Electrically Wound Time Switches.

Reliable electrically wound time switches for sign lighting, display window lighting, street lighting, two-rate meter installations, off-peak service, transformer substations, electric pumping stations, electric vehicle charging and many other purposes, have been long and persistently demanded by nearly every one connected with the electrical industry. The most difficult problem to be met by the manufacturer was the production of a time switch which could be depended upon to operate satisfactorily under every condition, regardless of all temperature changes and severe conditions that are imposed on time switches. The Minerallac Electrically Wound Time Switches are claimed to be so designed and constructed that they will meet every demand made on them in the most severe service.

In the development of time switches it was necessary to obtain a clock movement which would continue to operate under all conditions of service and under extreme changes of temperature.



In Electrically Wound Time Switches they use extremely heavy springs and keep these fully wound at all times. As the springs run down they close contacts on the motor and cause it to rewind through a set of differential gears. This winding through a differential always insures the springs being wound to an even torque or tension at all times.

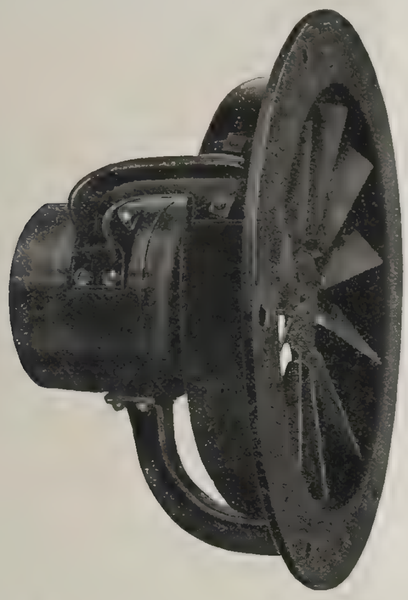
It was soon discovered, however, that the escapements obtainable were of such light construction that they would not withstand the wear and tear given a time switch in service. It then became necessary to manufacture escapements of sufficient weight and strength to take care of this heavy power at all times.

In order to produce a time switch to be dependable under every condition, it was necessary to build up a clock with the gears and pinions heavy enough to withstand the very severe usage to which a time switch is subjected. To reduce the wear and friction in the escapement (which is the heart of the clock) to a minimum, all shafts are mounted vertically. The escapement is very nicely balanced, so as to withstand hard usage and wear as well as extreme temperature changes. The escapement is made in a unit mounted on the top plate of the clock where it can be replaced, if necessary, without removing any part of the clock or switch. These electrically wound time switches are manufactured by Minerallac Elec. Co., Chicago, Ill.

New Ten-Inch Ventilating Fan.

This fan, recently developed by the Vacuum Car Ventilating Co., Chicago, Ill., can be furnished to operate either as a blower or an exhaust fan.

Thrust bearings are provided to permit of vertical or horizontal operation.



The fan is stamped from a single sheet of brass and has ten blades. It is riveted to a turned brass hub. At the operating speed the fan has a capacity of 800 to 900 cubic feet per minute, while under service conditions with restricted inlet the capacity will be in excess of 50 cu. ft.

The motor is a fully enclosed type supplied by The Robbins & Myers Co., Springfield, Ohio, and operates at 1750 R.p.m. The outfits are regularly furnished for operation on 85, 110 or 220 volts direct current and 110 or 220 volts alternating current.

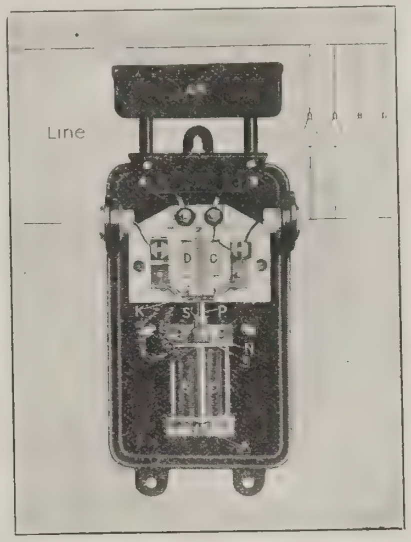
A New Flickering and Dimming Excess Indicator.

The increasing popularity of the controlled flat rate has brought with it a demand for new types of controlling instruments.

The Pittsburgh Electric Specialties Company, of Pittsburgh, Pa., has recently perfected and placed on the market a new flickering and dimming excess indicator to meet the demand for an instrument that will cut into the circuit automatically and reduce the current supply below the adjusted load whenever an attempt is made to use a flat iron, whether the lamps are in circuit or not.

This instrument operates on the same principle as the well known Flickering Excess Indicator, by causing the lamps to flicker whenever an overload of lamps is placed on the circuit and, in addition to this, it is provided with a dimming resistance which cuts into the circuit automatically as soon as an iron is placed on the circuit. It reduces the current flow in the circuit to less than eight-tenths of an ampere so that there is less than eight watts flowing in a 110 volt circuit.

This resistance prevents the heating of an iron under any conditions of service or length of time and at the same time relieves the instrument of any strain due to unnecessary operation of movable parts.



These instruments are made for use on both 110 volt and 220 volt circuits—A. C. or D. C. Broad patents covering this new feature have been granted. The detail of construction is shown in the accompanying photograph.

While numerous tests that have been made have proved conclusively that successful ironing cannot be done where the current is intermittently impressed on the iron, as is done by the indicator that flickers only, this improved type of indicator will appeal to central station men who have held the belief that flickering instruments, when subjected to overloads, such as is due to the use of an electric iron, would ultimately break down, due to the wear and tear incident to the operation of the working parts.

Vacuum Cleaner.

The Santo Manufacturing Company, 21st Street and Allegheny Avenue, Philadelphia, Pa., have recently placed on the market a new vacuum cleaner.

Probably the most noticeable departure is the new method of mounting the motor up on the handle instead of directly above or behind the cleaning tool. This method of construction dispenses with all wheels and castors, and makes possible the use of a renovator or cleaning nozzle that will go easily under radiators or heavy low furniture.

Another advantage instantly appreciated by the housewife is the swivel joint at the bottom which permits the handle to be dropped to either side (even to the floor if necessary) so as to get way back under beds, davenports, buffets, etc., without tipping the cleaning tool from a level position.

During the last few years since the first "Sweeper Type" Vacuum Cleaners was put on the market, dozens of makes have sprung into existence. While most of them accomplish quite thoroughly the work for which they are intended, they are practically all similar in construction and operation. The inability to reach inaccessible hard-to-get-at-places (where the dust and dirt always collects and where cleaning is most needed) has been the greatest fault with all of these various makes, because it is impossible to build a cleaner having a motor mounted on wheels near the renovator that can possibly run under anything standing less than six inches from the floor.

We show in the illustration, however, a little electric cleaner of the new design, that is not only radically different in appearance, but for which the manufacturers claim many advantages and exclusive features.

A small felt strip for polished floors, and a brush strip for rough floors may be instantly snapped into place in the aperture of the cleaning tool and as quickly removed with no other changes or addition of any extra adaptors.

Technical men will readily understand a further advantage in the design of this cleaner, in that it provides a direct passage for the inrushing air to the centre of the fan, and discharges it radially all the way around the outside—a feature impossible where the fan and motor are mounted between the cleaning nozzle and the dust bag.

Book Department

A feature of ELECTRICAL ENGINEERING hereafter will be the consideration given to the review, discussion and sale of books on engineering, techni al and business subjects. When properly treated, information about books is news whether the book m ntioned happens to be a new publication or an old one.

There are many valuable books on the market which ought to be in the library of every engineer, but many engineers know nothing about them because they have not been properly brought to their attention. We are going to supply this lack of information.

Every engineer and electrician needs books. The more responsible his position, the more necessary for him to have a library of his own to consult. The laborer alone needs no books, the professional man many; and between these two extremes there is a constant procession, some going up, others going down, according to whether or not they study.

All new books on subjects of interest to our readers will be reviewed by competent editors, and in a way to show to what class of readers they are of most value. In addition, we will give a brief synopsis of the contents of the books we list, so the readers will know whether they are suitable for their needs.

All books received will be reviewed, but all books reviewed will not be listed. There are good books, poor books and indifferent books published, so for the protection of our subscribers we will list only those books which in our judgment are good. There might be good books other than those we list, but of this you may rest assured; there will be no poor books offered for sale by our book department.

BOOKS REVIEWED.

Sanitary Refrigeration and Ice-Making.

By J. J. Cosgrove, author of Rock Excavating and Blasting; Sewage Purification and Disposal; Principles and Practice of Plumbing. Published by Technical Book Publishing Co.

The book is 6 x 9 inches, bound in cloth, contains 331 pages and 103 illustrations.

The varied uses of mechanical refrigeration, and the increasing number of refrigerating and ice-making plants, create a wide field for a book such as here described. The work is graphical rather than mathematical, practical rather than theoretical, and is intended for use in the engine room, the class room and the office. It is not a book for the experimenter or student of entropy, but will be found of great value to electrical engineers, refrigeration engineers, stationary engineers, ice-making and cold storage superintendents and salesmen for refrigerating machinery.

The illustrations are particularly clear and are made from original drawings, not from catalog cuts a practice only too common in many books. In the 331 pages of text, all branches of the subject are fully and clearly treated. The book will be found of particular value to electrical engineers.

The ice-making and cold storage industry is of growing importance to central station management in all parts of the country, but particularly in the South where it is a good load factor during summer and practically all the year when such plants furnish in addition cold storage service.

Present-day interest in refrigeration and ice-making is shown in the attention being given this sub

ject by the Natonal Electric Light Association. In the 1913 Proceedings of the Association, the report of the committee on refrigeration occupies 66 pages of comprehensive and intensely interesting matter, including descriptions of systems and apparatus; power required; examples of plants in operation and commercial methods used for obtaining business.

Further evidence of the combining of electrical production and cold storage which necessitates a knowledge of the subject of refrigeration by those ambitious to advance in the electrical field, is found in the activity of the organized refrigeration interests which at the third International Congress did much to increase knowledge of the subject of refrigeration and place the business on a scientific basis.

Recently, too, the state of Kansas passed a law permitting cities and towns within the state to buy or build ice-making and refrigeration plants. This places the employes of municipally owned electric light plants of that state in the same position as the engineers of public service corporations, so far as a knowledge of refrigeration is concerned.

In the volume which is the subject of this review will be found just the information needed for a course of home study on refrigeration and ice-making, and presented in such a clear, lucid, style with such a wealth of clear, original, line drawings, that those who want a book on the subject will make no mistake in selecting it. The book will be sent prepaid on receipt of price $3.50
Book Department, ELECTRICAL ENGINEERING.

CONSTANT VOLTAGE TRANSMISSION by H. B. Dwight. Published by John Wiley and Sons, 432 Fourth Ave., New York City. 125 pages. Price $1.25.

This work is by the author of "Transmission Line Formulas" and is written in the same practical style. The purpose of the book is to urge that more synchronous motors be installed in alternating-current power systems, and that dependence be placed on them to secure the desirable results of controlling the voltage of lines at the opposite end to that of usual practice, and of more than doubling the power load of most lines. In this way, the installation of comparatively inexpensive machines can take the place of building duplicate transmission lines. The decision regarding such important changes in design and operation, even when the examples described are kept in view, must be made according to thorough predeterminations of cost and operating characteristics. Working formulas, with examples, are given for these comparatively new calculations.

Although the writer is in favor of the increasing use of the principles of constant-voltage transmission, both in long distance work and local distribution, he has tried to show impartially both sides of the case, and to outline the conditions where the new method is not applicable.

HOW TO MAKE A TRANSFORMER FOR LOW PRESSURES is the title of a small book designed for "young America" by Professor F E. Austin, Hanover, N. H. The book gives specific directions for procedure in constructing transformers, and the many transformers built according to the specifications have shown wonderfully high efficiencies for small devices. The small transformers, when connected with the ordinary alternating current house circuits, may be used to operate small electric lights, doorbells, small arc lights, and direct current toy railways, operating five or six loaded trains at one time. The test is sufficiently suggestive throughout to invite initiative on the part of the reader to deivate from the 19 clauses of the specifications and effect many variations. The price of the book is 25 cents.

A new book entitled "DIRECTIONS FOR DESIGNING, MAKING AND OPERATING HIGH PRESSURE TRANSFORMERS," written for those experimenters who desire to construct their own apparatus, is also published by Prof. F. E. Austin. The book is a companion volume of "How to Make a Transformer for Low Pressures," but containing more working directions and useful talks such as loss due to Hysteresis, per cubic inch of iron core for various flux densities and frequencies; and data applying to copper magnet wire. The book is well illustrated with half-tone and line cuts showing special methods of procedure, fundamental theories, and finished apparatus. It is written in simple English, is full of technical information and new ideas relating to methods of design and construction, and will prove of great assistance to those who are pursuing correspondence courses or regular college courses. The price of the book is 50 cents.

Trade Publications.

Descriptive Leaflet No. 3796, issued by the Westinghouse Electric & Mfg. Company, covers small direct-current generators known as type CD, ranging in capacity from ¼ kw. to 2 kw., and 125 to 250 volts. These generators are particularly adapted for use as exciters, charging storage batteries, lighting country residences and small industrial plants in localities where central station power is not available.

The switchboard publications, giving unusually complete information, have just been issued by the Westinghouse Electric & Mfg. Company, namely, Sections DS 1439 and 1456, the former covering alternating-current boards with hand-operated switchboard-mounting oil circuit-breakers, and the latter, rotary converter panels.

Complete detail information is given on these two types of boards, including a number of diagrams, and suggestions as to the best method of assembly.

The Relation of Trolley Feeder Taps to Machine Flash-Overs, is the title of an article which recently appeared in an electric journal. This has been issued in pamphlet form by the Westinghouse Electric & Mfg. Company (Reprint No. 10). This article discussing this question, giving the reasons for the application of the tap and the various conditions effecting the flash-over, quoting numerous incidents where rotary converters had flashed over.

Textile Quarterly No. 9, issued by the Westinghouse Electric & Mfg. Company, is devoted to a description of the new pressed steel frame induction motor recently brought out by this company, and especially adapted for textile work. The method of rolling frames is described and illustrated, and other details of construction are carefully explained. The method of testing the motor against shocks and vibrations is also explained and pictures are shown of the motor under test.

The Delta-Star Electric Company, Chicago, are distributing a new folder No. 49, describing the automatic high speed sphere gap S & C arrester. The valve action of this arrester is well demonstrated, and will be of interest to those interested in high tension transmission.

Personal Notes and Comments.

Mr. D. H. Braymer, formerly Editor of ELECTRICAL ENGINEERING, has resigned, to become Associate Editor of "Electrical World." During the five years of his service as Editor of ELECTRICAL ENGINEERING, he earnestly served the electrical interests of the South and made many friends among the electrical fraternity. He leaves with the best wishes of his associates and friends for his continued success.

Electrical Engineers Equipment Co., Chicago, Ill., announce the appointment of Mr. Frank E. Getts as general manager of the company. Mr. Getts was formerly district sales manager for the Alberger Pump & Condenser Co., Chicago.

The National Metal Molding Co., manufacturers of electrical conduits and fittings, Pittsburgh, with offices in various cities, has recently opened offices at 801-802 Electric Bldg., Buffalo, from which to handle their increasing business in western New York and Canada. This office will be under the charge of Mr. L. S. Montgomery, who has represented the company in the South and other sections for a number of years and is especially well known in the electrical trade. Mr. Montgomery is a prominent and active Jovian and was Apollo in the Eleventh Jovian Congress.

Simplex Wire & Cable Company of Boston, Mass., is now represented in New York City by Mr. William K. Sparrow with an office at 30 Church Street. Mr. Sparrow has been connected with the electrical industry in and around New York since 1887, having been associated with the Edison Machine Works, Manhattan Electric Light Company and the Brooklyn Edison Company. In 1892, he had charge

of the construction of the underground system of the W ~ld's Columbian Exposition at Chicago. From 1902 to 1914, Mr. Sparrow was sales manager for the Fibre Conduit Company.

The Delta-Star Electric Company, Chicago, is distributing a unique "box model" of a standard steel tower outdoor high tension sub-station. The model is of the folding type, and has been found very useful to constructing engineers called upon to erect outdoor sub-stations. One of these models can be secured upon request.

The Terry Steam Turbine Co. announces the appointment of Mr. Merton A. Pocock as district sales manager for the territory included in the states of Minnesota, North Dakota, and South Dakota. His office is 400 Endicott Building, St. Paul, and this arrangement supersedes the previous selling agreement with Robinson, Cary & Sands Co. of St. Paul.

They have also appointed the Hawkins-Hamilton Co., Peoples National Bank Building, Lynchburg, Va., their representative for the state of Virginia.

INDUSTRIAL NOTES.

BRISTOL, TENN. The City of Bristol has been authorized by the State Legislature to issue bonds to the extent of $100,000 to establish a municipal electric light plant.

ERWIN, TENN. A hydro-electric power plant is to be erected in Erwin, Tenn. A water power site including five hundred acres of land on the Nolichucky River is reported to have been purchased by Heath & Company of Charlotte, N. C., for the purpose.

WINDER, GA. This city is to abandon their steam electric generating plant and obtain electricity from the Georgia Railway & Power Co. of Atlanta to operate the municipal system. The power company will extend its transmission lines from Gainesville to Winder.

OPELIKA, ALA. The local business men of this city have under consideration the installation of an ornamental street lighting system in the business district.

SCOTTSBORO, ALA. The Chattanooga-Tennessee River Power Company of Chattanooga has a representative, Mr. M. R. Sterins, in Scottsboro, making investigations with the view of erecting an electric transmission line from Hale's Bar on Tennessee River to Scottsboro. The company is also considering an application for a thirty-year franchise and contract for street lighting.

SELMA, ALA. The city council is considering the matter of requiring all overhead electric wires being placed underground within the city limits.

WHITECASTLE, LA. A municipal electric lighting plant to cost about $30,000 is being planned for this city. Mr. Xavier A. Kramer of Magnolia, Miss., is engineer.

MANNSVILLE, OKLA. Bonds to the amount of $5,550 have been voted to purchase the local electric lighting plant.

STRAWN, TEXAS. The Strawn Coal Company is reported to be planning the construction of an electric light plant to replace the present equipment.

WINNSBORO, N. C. The erection of a 22,000 volt transmission line from the plant of the Power Shoals Power Company on Broad River to Winnsboro is being considered by the Board of Public Works. They are also considering the construction of a sub-station to establish a twenty-four hour service. T. R. Ellison is superintendent.

SUCCESS, ARK. A franchise has been granted to Geo. Boozer of Corning, Ark., to construct and operate an electric lighting plant in Success. Current for operating the system will be supplied by the Corning plant.

SAN BENITO, TEX. Plans have been adopted by the City Council for a complete street lightnig system which will be installed at once.

WARSAW, N. C. A franchise has been granted by the City Council to Messrs. Oliver & Gettit of Clinton, to construct and operate an electric light plant in Warsaw.

ATLANTA, GA. The Atlantic Stone Company which operates extensive quarries and waterworks on Broad River in Elbert County has obtained permission to construct a hydro-electric power plant. Wm. Hurd Taylor, Trust Company of Georgia Bldg., Atlanta, is treasurer.

TOCCOA, GA. It was voted at a recent election to issue $35,000 in bonds for the installation of an electric light plant.

ST. AUGUSTINE, FLA. It was reported that plans are being considered by the Jacksonville and St. Augustine Public Service Corporation for the installation of an electric power plant.

BRAEMER, TENN. A hydro-electric power plant at Braemer Falls, on Lowell Creek to develop 1,000 horsepower is being contemplated by the Braemer Power Company recently organized. The present plan provides for the construction of a dam one hundred feet high, and to convey water from the dam by flume to mountain side, wheel penstocks will convey water to water wheels. Officers are W. P. Dungan, president; Sexton W. Dungan, vice-president; L. D. Gastieger, secretary and treasurer; H. Graveson, general manager.

OPELIKA, ALA. Bids will be opened at the office of the Supervising Architect, Treasury Department, Washington, D. C., until July 14th for construction complete, including mechanical equipment except elevators, lighting fixtures and approaches, of the United States Post Office building at Opelika. Drawings and specifications may be obtained at the above office or from the custodian of site at Opelika.

This Issue 9,000 Copies

ELECTRICAL ENGINEERING

Vol. 47. AUGUST, 1915. No. 8

Stevens Creek Development of the Georgia-Carolina Power Company

W. C. Hanson.

The Stevens Creek Development of the Georgia-Carolina Power Co. is located on the Georgia side of the Savannah river, nine miles above Augusta, Georgia. The development derives its name from its location near the mouth of Stevens Creek, which empties into the river just above the power dam on the South Carolina side.

There is a total of 31,250 H. P. available, but in the first installation of the building and the equipment, provision for only half of this power is made. Power is transmitted at 44,000 volts to substations located in Augusta, Ga., Clearwater and Aiken, S. C., the total distance being twenty-five miles. The building is arranged for two groups of five generators each with the exciters and the switch-board located between the two groups. The present building includes one generator group and all of the exciter and switch-board section. The dam is 2,700 feet long, 35 ft. 5 in. wide at the base, and averages 30 ft. above rock. The normal head is 27 ft. and the dam is built for a maximum flood capacity of 450,000 cu. ft. per sec. and a maximum depth on the spillway of 14 ft. 6 in. The spillway section of the dam is 2,000 ft. long. It is arranged to take 4 ft. of flash boards. Between the power house and the spillway, navigation locks 30 ft. wide by 150 ft. long are located. The river immediately below the dam is navigable for shallow water boats only. With the pond extending 13 miles up the river, and a proposed channel below the dam, it is expected that river traffic will be greatly increased for carrying cotton and other products.

Fig. 1. Power House and Dam.

Immediately beyond the locks, the spillway section of the dam contains five sluice gates. The sluice openings are eight feet square and will carry off 2,000 cu. ft. per sec. each. The mechanisms for operating these gates are located in a tunnel in the dam and are arranged for hand operation at the present time with provision for future motor operation.

Water gauge boards above and below the dam give the conditions of the river flow. These readings are recorded on the station log sheets, and it is proposed to make use of them in giving the flood conditions for the city of Augusta, since this is of such vital importance to the community.

Main Turbines.

The five main turbines are of the vertical re-action type. They have a capacity of 3125 H. P. at 75 R. P. M. and 27 ft. head. The overall diameter of the runners is 11 ft. 6½ in., the nominal diameter 8 ft. 8 in. and the weight about 30,000 pounds. Pivoted guide vanes extending around the runner are opened and closed by the turning of a movable head to which they are attached by means of levers and connecting links. This turbine head is revolved through a small angle by means of a piston and double ended cylinder. Oil under pressure coming into one end of the cylinder closes the gates and into the other end opens them. When one end of the cylinder is under pressure, the oil in the other end is released. This action is controlled by a four-way valve on the governor. The oil is pumped by two motor driven triplex pumps into accumulator tanks located at each machine where the pressure is maintained from 125 pounds to 150 pounds. After the oil is released from the operating cylinder, it is returned to reservoir tanks in the basement under the exciters from which it is again drawn by the pumps. Air is kept above the oil in the accumulator tanks by means of an air compressor, which is operated at intervals, depending on the leakage. It is this air which maintains the pressure on the oil. A by-pass valve on the pressure line at the oil pumps which run continually is controlled by the pressure in the accumulator tanks. When this pressure is lower than 125 pounds, the by pass valve is closed and the oil goes to the accumulator tanks. When the pressure reaches 150 pounds, the valve opens and the oil passes to the storage tanks. Check valves prevent the

return of the oil from the pressure system.

The triplex pumps are driven by 40 H. P., 2300 volts, 3 phase motors. They are of the slip ring type, and start with external resistance located in a controller alongside the motor. The future equipment provides for one additional pump. The air compressor of this system is driven by a 3 H. P., 110 volt 3 phase motor.

Main Generators.

The generators are of the vertical type with revolving field 3 phase, 60 cycle, 2300 volts, 690 amperes, and rated at 2700 K. V. A. at 75 per cent power factor, and 75 R. P. M. The total weight of the revolving parts including the turbine runner is carried by a Kingsbury thrust-bearing supported by an eight arm spider bracket above the machine. The movable part of the bearing consists of a thrust collar which is screwed and pinned on the shaft. The fixed part consists of six babbitted shoes which set on a centering collar which in turn fits on a bearing block. The contact surface between this collar and block is spherical, giving a ball and socket effect which allows the revolving part of the generator to center itself. Spaces between the shoes allow oil to circulate between them. When the generator is turning, a film of oil is drawn between the shoes and the thrust collar, the movement of the oil being away from the shaft. It is this film of oil which carries the weight of the moving parts. When the generator reaches a certain critical speed, this film is formed, and there is then no actual contact between the surfaces of the bearing shoes and the thrust collar. This speed is about 20 R. P. M. so that the wear on the blocks takes place only at starting and stopping. The time required in stopping is so much longer than in starting, that the principal wearing takes place when the machine is being shut down. Advantage is taken of this action before the machine is put in service. It is started and stopped at frequent intervals until the bearing surface of the shoes is worn, thus giving a finish that could not otherwise be attained. After these trials, the bearing is taken apart, inspected, cleaned and scraped if found necessary. The oil level is kept above the bearing shoes and a circulation is provided for this oil by allowing it to run to a cooling pan beneath the bearing bracket. It is pumped to the bearing again by means of a rotary pump, which is driven direct from the shaft. This pan was arranged for water-cooling coils, but the coils were not installed at this time, since the heating of the oil did not warrant it.

Air for cooling the generator is drawn into the base through concrete air ducts which open to the outside of the building. The heated air is expelled into the room.

Exciter Turbines.

The exciter turbines are of the vertical type, 450 H. P., and operate at a speed of 200 R. P. M. Two only were provided for the equipment, and both were installed at this time. The runner weighs 5,000 pounds, has an overall diameter of 4 ft. 5¼ in., and a nominal diameter of 3 ft.

Fig. 2. Interior View of Power House.

4 in. Pelton governors are used and are driven direct from the shafts. They are not connected with the central oil system of the generators. The operation of the gates is practically the same as with the generators.

Exciter Generators.

The two exciter generators are of the vertical type. Each has a capacity of 300 K. W. at 250 volts and is capable of exciting five generators. Balance coils connected to slip rings are used to give 125 volts from the outsides to the neutral to furnish power for lighting and for the operation of oil switches in emergency cases. The roller bearings at the top of the generator carry the turbine runner as well as the armature. The oil circulating system for this bearing is the same as for the main generators. The future equipment provides for a 300 K. W. motor driven exciter which will be located back of the switch board.

Transformers.

Three transformers were installed at this time and the future extension will require two more. They are rated at 5400 K. V. A., 3 phase, 60 cycles, 2300 volts to 44000 volts, delta connected. They weigh 68,600 pounds each, are oil insulated, and have four water cooling coils. These coils enter and are supported at the cover, so that they are covered with tape inside the transformer where they do not extend into the oil, so that moisture is not condensed on the pipes. The transformer tank is cylindrical in shape, the

Fig. 3. Water Wheel Runner.

base is square and is provided with flanged wheels. These rest on rails embedded in the floor, so that the transformers can be moved from their normal positions in the bay to a position on the floor, where they can be lifted by the crane. U-bolts in the wall and floor enable the crane to be used in moving the transformers on the rails. A thermometer with electrical alarm attachment and an oil gauge are set near the top of the tank. A large elbow on the cover of the transformer case allows a relief in case of rise in pressure of the tank. This opening is covered with a treated paper so that air does not enter under normal conditions. In order to empty the transformer of oil in case of emergency, a six inch quick-opening valve connects to a pipe which drains to the river on the down stream side of the power house. The transformer sets over a pit six inches in depth which is also drained to the river.

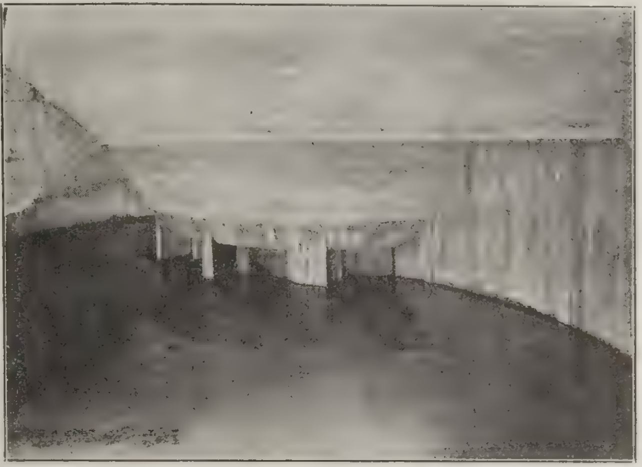


Fig. 4. Gates of Water Wheel.

Bus Structures.

There are three switch structures each containing two E 600 three pole oil switches for two generators, one E 2000 for the bus tie and one C 2000 for the transformer. A transfer bus connects these switch structures. It has a capacity of two generators. The cables from the generators to the bus structure are carried in two inch fibre conduits in the floor. There are two 500,000 c. m., varnished cambric, lead covered cables per phase. The connections from the switch structures to the transformers are made by overhead copper bars supported from steel work.

The station auxiliary load is taken from the transfer bus through a C 600 switch located in a switch cell back of the switch board.

High Tension Wiring.

The high tension side of the transformer is connected to the 44,000 volt buses through type G. A. 300 oil switches, and the outgoing feeders through type G. A. 500 oil switches.

The type of disconnecting switch used on the high tension is shown in Fig. 6. The six pole type is used on the feeders and the three pole type on the transformers. Contact rods A are fastened rigidly to the insulators B which are attached to the movable cross beam C. The rods slide through guides on the terminal insulators D. Turning the crank handle on the post raises or lowers the cross beam C by means of chains, gears, and shaft E. Guide blocks on the ends of C move on guide rods and the weight of the beam, insulators, etc., is balanced by counter weights. The insulators used on this switch are the post type with three discs. The high tension wiring for the buses and line switches is of ¾ inch copper bar, and for the transformers is ¾ inch copper tube. The bases are supported by pin type insulators which are fastened to the roof purlins of the lower bay. The choke coils are suspended from roof bushings and the horn gaps for the arresters are supported on steel work outside the building. The lightning arresters are located on the two galleries and the horn gaps are also operated at these points.

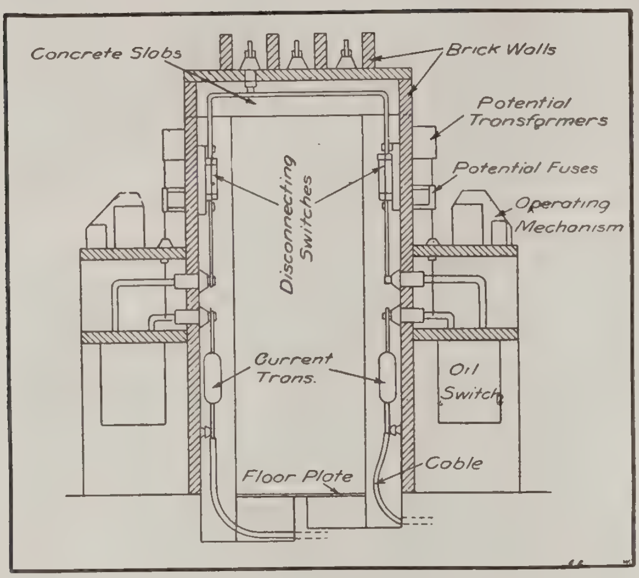


Fig. 5. Section Through Bus Structure.

Switch Board.

The switch board consists of seventeen panels of natural black slate with oil finish. The panels are 90 inches high, divided into three sections, and are supported by angle iron frame work. The meters are black faced and mimic bus bars on the face of the board show the A. C. connections, disconnecting and oil switches, transformers, generators, etc.

Cooling Water System.

The river water which is used for both the camp and transformer systems requires filtering, due to its muddy condition. Alum is introduced into the raw water which is pumped to a settling tank where the foreign matter is precipitated to some extent. From this tank the water passes through a 60 inch gravity filter into a receiving tank. From here it is pumped to the camp reservoir. The pumps

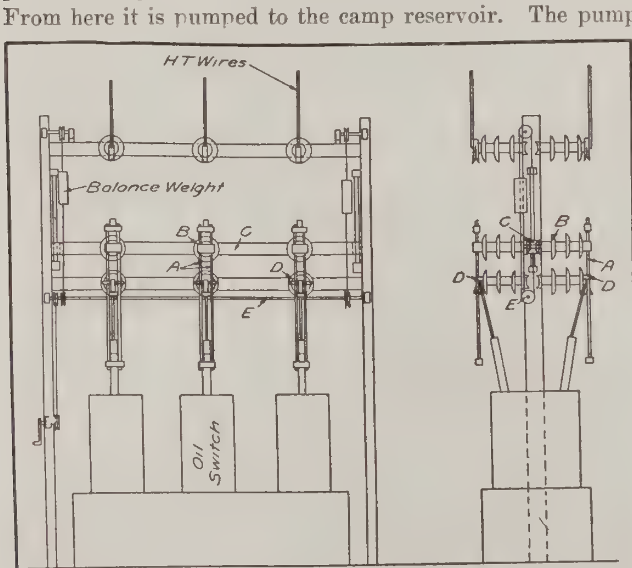


Fig. 6. High Tension Disconnecting Switches.

are piped so that either or both can pump the filtered or raw water. An octagonal concrete cooling basin 40 ft. across and 3 ft. deep located on the hillside near the power house receives water from the camp line through a float valve which keeps the level constant. This cooling pond was installed so that only a small quantity of make-up water had to be supplied from the filter system to supply the needs of the transformers. From the cooling basin the water goes through a strainer to centrifugal pumps which force it through the transformer coils and then to the sprays in the center of the basin. The two centrifugal pumps used are two inch, single suction, 125 gal. per minute, discharge head 125 ft., suction head 25 ft. They are direct connected to 7½ H. P., 110 volts, 3 phase motors. The camp pumps are 10 G. P. M., 150 ft. head, triplex, single acting, plunger pumps.

Oil System.

The oil system consists of a 25 G. P. M., 80 pound, rotary oil pump, direct connected to a 5 H. P. 3 phase, 110 volt, induction motor, a 12 in., square, two-eyed, 18 chamber, closed delivery oil filter press furnished by T. Shriver and Co., and the piping as shown in Fig. 12. The 4,000 gal. reservoir is located outside of the building. The pressure and suction headers are carried by brackets on the head wall about 2 ft. above the floor, and are connected to the transformer. H. T. switch tanks and outlets are also provided for the bus structure switches and for the arrest-

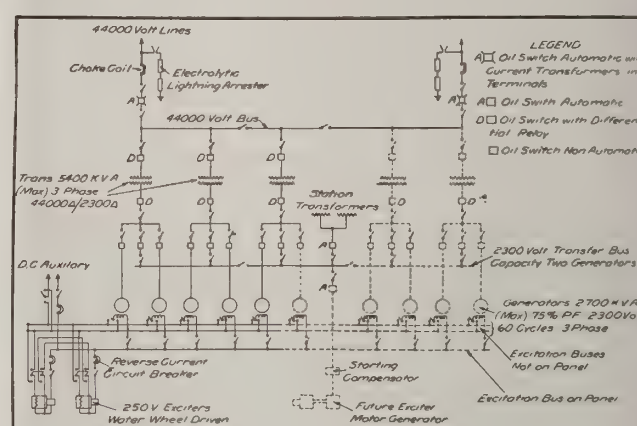


Fig. 7. Diagram of Wiring Connectons.

ers. With the piping as shown, the oil can be circulated around the transformer and filter, or can be stored in the reservoir from which it can be pumped when required. A three heat electric drying oven is used for drying the blotting papers. After they are dried, they are placed in a container of oil in which they are kept until ready for the filter press.

Alarm and Signal System.

Transformers:—When the temperature gets to a predetermined point, the thermometer on the transformer closes a circuit which rings an alarm bell and operates a drop corresponding to the number of the transformer. This alarm continues to ring until the temperature is reduced below the point.

Oil Switches:—The relays of the oil switches close a bell relay circuit when they operate and trip their switches. This alarm bell continues to ring until released by the operator.

Generator Bearing Oil Supply:—Sight flow indicators with electrical contacts were installed on the oil pipes of the generator and exciter bearings to insure continuous flow. The alarm system connected to these indicators is shown in Fig. 10. When the contact at the indicator is broken due to the stopping of the oil flow, a low voltage relay closes an alarm bell circuit at the switch board. At the same time an indicating lamp on the generator lights, thus showing which generator is in trouble.

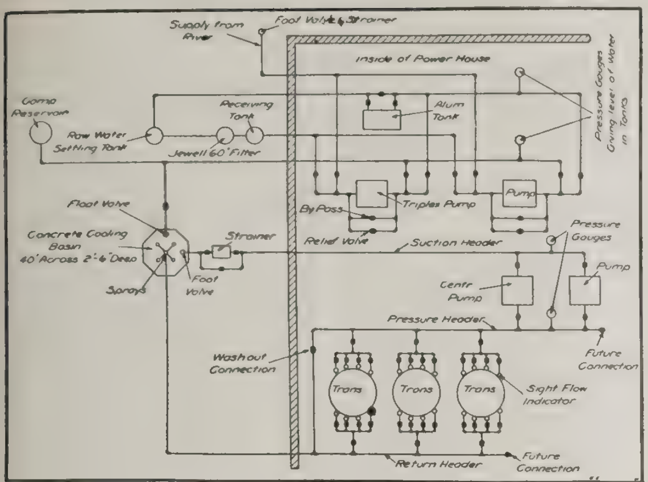


Fig. 8. Diagram of Water System Piping.

Signals:—Signal posts are located at each machine for the control of the water wheels. They are equipped with buttons and indicating lights which are connected with corresponding ones on the switch board for starting, stopping, changing load, etc. An electric horn at the switch board can also be operated at the machines and at the board to call either operator's attention. An illuminated sign signal, which can be seen from all parts of the floor, contains the numbers of the generators and exciters. The lights in this signal are controlled at the switch board. It is used in conjunction with the horn in calling the attention of the floor man.

STORAGE BATTERY.

All power for the control of switches, governor motors,

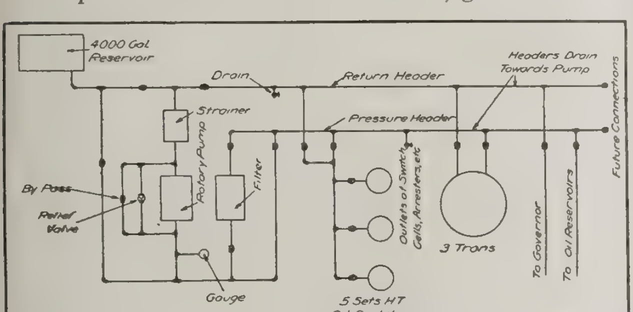


Fig. 9. Diagram of Oil System Piping.

rheostats, etc., is furnished by a 55 cell, 110 volt storage battery, which has a capacity of 20 amperes for eight hours. This battery is in the brick enclosed room on the east gallery. It has separate ventilation, vapor proof lighting fixtures, and all wood work and metal in the room is painted with an acid proof paint. The battery is mounted on a two tier wooden rack which extends around the walls of the room. It is charged by a 5 Kw. motor generator set which is operated from the 110 volt auxiliary supply. The operating buses can be thrown on the exciter 125 volt circuit, but this is done only in case of emergency. The battery is also used for lighting emergency lights located around the buildings.

AUXILIARY.

The power for the station auxiliary is distributed from an open bus mounted on pipe framework in the gallery over the switch board. There are two sources of supply for this bus. One is through the type C 600 oil switch already mentioned, and the other is by means of cables running to the switch structure of generators 3 and 4. In an emergency these jumpers can be attached to the switches of either generator.

Three 10 K. V. A., single phase, 60 cycles, 2300 to 115 volts transformers are used for the power supply in the station, and two 15 K. V. A., single-phase, 60 cycles, 2300 to 115 volts transformers are used for the lighting.

The 40 Hp. motors of the governor oil pumps are supplied from this 2300 volt bus and are constrolled by type H oil switches located at each motor.

Fuses for the 110 volt circuits supplying the transformer water pumps, camp water pumps, sump pumps, oil pump and the two air compressors are mounted above the transformers, and the cables run to the various motors through conduits.

CABLE AND CONDUIT SYSTEMS.

All the cables and wires are run in conduit. Fibre conduits are used for the generator and exciter mains and galvaduct conduits for all other cables.

In building the substructure of the power house, the concrete was brought up to elevation 168 which is one foot

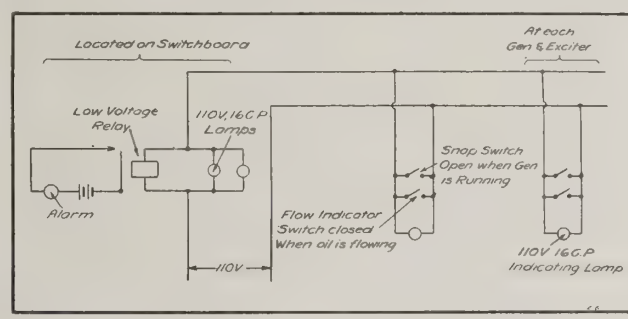


Fig. 10. Generator Bearing Oil Alarm.

below the finished floor level. The conduits and air pipes were all laid before this one foot slab was poured. A series of man holes about 2 feet wide by 4 feet long by 1 foot deep extend the length of the switchboard. They are separated by 4 inch walls, so that in effect they form a cable trench in back of the switch board; steel plates cover this trench.

GROUND SYSTEM.

All generators and exciters were grounded to their water wheel casings. The main station ground consists of 1/0 bare stranded cable supported along the head wall above the

Fig. 11. Gallery at Switchboard.

Fig. 12. Cross Country Towers.

water and oil pipes. To this bus connections were made to all oil switch mechanisms and tanks, transformers, switch board ground wires and supports, and the steel work of the building at number of places. Connections for the grounds were made to the trash racks at the intakes. Separate ground wires were run to the racks for the lightning arresters.

TESTING RHEOSTAT.

A floating rheostat was built to carry the full load of the machines to use in testing the turbines. This consisted of a wooden framework of 2 inches x 3 inches and 4 inches x 6 inches, to which were bolted G. E. railway grids No. 26513. Taps were arranged so that delta and star connections could be made for a number of different loads at the normal voltage of the generator. Barrels were used to float the rheostat at a level which kept the grids about 9 inches under water. A walkway a few inches above water facilitated inspection and connecting. The taps to the different points were brought out and attached to this walkway. Fender boards were arranged to keep floating and submerged debris from coming into contact with the grids.

TRANSMISSION LINES.

Two feeders and one telephone line were carried on steel towers from the power house at Stevens Creek to the Augusta substation and one feeder and one telephone line from the Augusta substation to Aiken and Clearwater. Three types of towers were used in the transmission line: cross country, small base, and special lake crossing.

Seventy cross country towers, Fig. 12, of galvanized steel, were used from the power house to the city limits. The standard towers are 65 feet high with the lowest cross arm 50 feet from the ground and the other arms spaced 6 feet apart. The four legs are 14 feet apart at the base and 3 feet at the top. They are attached to anchor plates set 6 feet in the ground and covered with a sleeve of concrete at the surface. On account of the topographical conditions, the height of three of the cross country towers was increased 10 feet by adding a section at the base. The average spacing of these towers is 550 feet.

Small base towers, Fig. 16, were used within the city limits. Due to the road and canal crossings, three sizes of towers were used. Fifteen towers are 55 feet from the base to the top, four are 60 feet, and three are 65 feet. The distances from the ground to the lowest cross arms are 40, 45 and 50 feet, respectively. They were set on concrete foundations containing from 10 to 14 yards of 1-3-6 concrete. The 1 3/8 inch x 7'0 inch anchor bolts were attached to anchor plates in the concrete. The normal spacing of these towers is 175 feet and the weight is about three tons.

Two special Lake Olmstead crossing towers, Fig. 13, are 74 feet high and the spacing of the legs at the base 20 feet x 23 feet. The anchor bolts in the foundations of these towers are $1\frac{1}{2}$ inch diameter x 7 feet long. Two wires of each circuit are carried in a horizontal line by the top plate of the tower. Ten feet below this plate the other wire of each circuit and the two telephone wires are carried in another horizontal line. This span is 900 feet long.

The materials used in the Stevens Creek Development of the Georgia-Carolina Power Company were furnished by the following firms:

Turbines—I. P. Morris Co., Philadelphia, Pa.

Governor System—I. P. Morris Co., Philadelphia, Pa.

Main Generators—Westinghouse Electric & Mfg. Co., Pittsburgh Pa.

Exciter Turbines—I. P. Morris Co., Philadelphia, Pa.

Exciter Generators—Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Insulators, High-Tension System Switch—R. Thomas & Sons Co., East Liverpool, Ohio.

Feeder Insulators—The Ohio Brass Co., Mansfield, Ohio.

Storage Batteries—United States Light and Heating Co., New York City.

Fuses—Pyrene Mfg. Co., New York City.

Fittings—V-V Fittings Co., Philadelphia, Pa.

Cross Country Towers—Milliken Bros., New York City.

Small-Base Towers—Virginia Bridge & Iron Co., Roanoke, Va.

Crossing Towers—Virginia Bridge & Iron Co., Roanoke, Va.

Line Strain Insulators—R. Thomas & Sons Co., East Liverpool, Ohio.

Engineering and Construction Work—J. C. White Engineering Corporation, New York City.

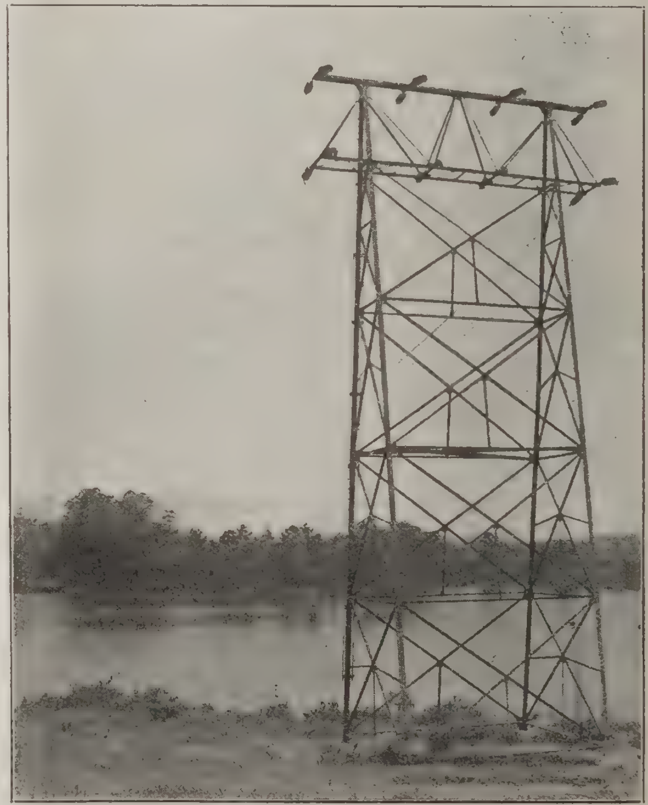


Fig. 13. Stevens Creek Transmission Line.

Municipal Regulation of Public Utilities

By John H. Roemer.

When the regulation of public utilities by municipal councils, generally called "home rule," is urged, its advocates do not seem to realize that state regulation is increasingly finding its justification, not in a political theory, but in the complexity of our civilization, and the growth of the public service industries to meet the needs of that civilization in the most economical way possible.

Through the advance of the sciences involved in those industries and through superior business organization, the interests of cities, towns, villages and countryside are to a greater and greater extent common interests. Public utilities are forming a more and more important factor in the economic life of the people, wherever living.

Doubtless in the early days of the various public utility industries, they were largely local in character, confining their operations to the various municipalities in which they happened to be located. However, the operations of public utilities are becoming less and less merely co-extensive with the boundaries of any one municipality.

Thus, the city street railway system develops into the suburban and finally interurban. The long distance and rural telephone connections form a most valuable part of municipal telephone service. In the field of electric light and power, long distance transmission of current ignores absolutely municipal boundaries. Even with gas it sometmes happens that it is manufactured in one municipality and pumped to another, and where there is natural gas, almost invariably a number of municipalities are involved. Even water, when wells, lakes or rivers are not available, is frequently piped long distances, sometimes supplying several municipalities en route.

The growth of interurban mileage of both telephone companies and electric railways, the growth of the electric light and power industry, including development of water powers, and especially the marked tendency in the latter industry for the large central generating plant, with transmission lines, to displace the small independent plant—are all facts neither fully known nor appreciated by the public generally. This growth has been in the direction of fewer—at least of larger—systems; of consolidation and centralization, and away from the single municipality as a unit of service.

Statistics show that the telephone companies with an annual income of $5,000 or more, have decreased in number 53.8 per cent in the last ten years, but the number of telephones has increased 216.4 per cent and the number per 1,000 of population from 30 to 90. At the same time the estimated number of messages or talks classified as local exchange, has increased 170.6 per cent and those classified as long distance or toll, 182.3 per cent. While the companies taken as a whole have shown such a marked decrease in number along with an extraordinary growth in equipment, number of patrons, etc., the smaller systems reporting an annual income of less than $5,000 including farmer or rural lines, have also shown a substantial increase both as to number and equipment.

The economic development of the electric public service industry has been found to lie certainly in larger and larger units of production. Considering the enormous increase in power and capacity from 1907 to 1912, the assumption seems reasonable that the end of this tendency is assuredly not yet in sight. Thus, from 1907 to 1912, due to the development of the turbine, the total horsepower developed increased over ten times as fast as the increase in the number of primary power machines.

Great as has been the increase in the development of primary power machines, it is far greater in the case of dynamos. Here the most phenomenal increase occurred. An inspection of the percentages reveals the astounding, almost incredible, fact that the total capacity increased nearly 360 times greater than the number of machines. The increase was not so great from 1907 to 1812, but still over 25 times as great.

From the foregoing it follows, as a general thing, that economy in this industry lies in the large generating station, and in the ability to mass enormous production. The municipality owned stations with primary power machines and dynamos of much smaller average capacity than the commercial stations, produce and sell their energy at a much higher cost relatively. But the larger hydro-electric stations far surpass the general average of either or of both.

The larger hydro-electric class, while constituting only 4.3 per cent of all the stations, produces 50.8 per cent of the entire output at a unit cost of 47.3 per cent of the general average. Were these stations to be excluded in reaching the general average, and, strictly speaking, they probably should be, the contrast would doubtless be much greater.

A paper presented at the Public Policy Meeting of the National Electric Light Association Convention, San Francisco, Thursday Evening, June 10, 1915.

The economy in favor of the large plants in even more marked in Wisconsin than in the United States at large. In Wisconsin the hydro-electric plants produce 48.01 per cent of the total output at a unit cost only 20.0 per cent that of the general average.

It is very evident that the small isolated plant supplying the town or village cannot compete economically with the substation on the transmission line of the big generating plant. Not only is the present trend towards larger and larger generating plants with networks of transmission lines spreading over the country, because of the economy of enormous production, but because of the fact that electrical energy cannot be stored. This means that the more evenly the energy generated can be distributed over the twenty-four hours and from day to day, the closer will be the relation between the total demand and the total capacity of the plant, resulting in a better balance between the necessary investment and the total business required to pay fixed charges on that investment.

This principle has been illustrated substantially as follows: If a given amount of electric power is consumed within one hour of the twenty-four, but none the remaining twenty-three hours, the plant must be twenty-four times as large as though the same consumption were distributed evenly over the twenty-four hours. In either case there is the same amount of business but it will be much more costly in the former case than in the latter as the investment must be far greater and interest charges proportionately heavier. The large system supplying an extensive territory with divergent needs has this advantage over the isolated plant of greater opportunity for more economic distribution, resulting in a better load factor.

Growth in the electrical public service business and its economic changes have been so recent that there has not been sufficient time for the business as a whole to adjust itself. However, the 1912 census report informs us that in 1912 the proportion of stations buying current for distribution was double that in 1907, and states that there has been an even more pronounced tendency towards centralization of ownership and operation in 1912 than in 1907, but unfortunately the report does not present the statistics gathered in such form as to clearly bring out this fact.

The economic development and distribution of electric energy is most vividly shown by the operation of the holding companies and large operating companies. Perhaps as clear an illustration as may be found among the many that might be cited of the benefit resulting to the public from a consolidation or combination of small electric utilities is the case of the Central Illnois Utilities Company. This company is serving 23 or more communities in Illinois with current for light and power from a single station. Formerly these communities were served by 9 small separate generating plants.

Another illustration is the Central Illinois Public Service Company which serve over 100 communities. Before consolidation these communities were served by 34 separate generating plants. Most of these have been closed down and shortly all these communities will be served by eight large central stations.

Comparison of service and rates in the communities served by these Companies with those formerly in effect should furnish an object lesson to those who advocate the purchase or construction of isolated plants by municipalities.

When one appreciates how increasingly inter-related and inter-dependent public service companies are becoming, both as to their physical operation and their corporate control and ownership, one can hardly help asking himself—

Would absolute home rule of all public service companies be successful and would municipal ownership promote the most economic development of public utilities?

Consideration of the great difficulties involved must inevitably lead one to the conclusion that the answer to the first question is emphatically "no" and consideration of the direction that the economic development of utilities has taken, must lead one to the conclusion that the answer to the second question is also "no." In fact it has been suggested that if there is to be public ownership at all, a state ownership rather than municipal might often be more in line with the present and promised development of the public service industries.

Turning again to the question of "home rule," we find that difficulties spring up on every side. Perhaps the first difficulty which suggests itself is that the municipality's powers in the absence of delegation of special power by the legislature, are only co-existent with its own boundaries.

Now, the utility is entitled to a fair return on the value of the property devoted to the service for which the rates are being made. Thus, if a given company is serving, let us say, cities A, B and C from B, as a distributing point, it is, of course, proper that its rates in A should be sufficient to give a fair return on the value of the investment made necessary to give A its service. The mere statemnt of this fact is sufficient to convince one that it is the only reasonable ground on which to proceed—a fact generally admitted and given the approval of the United States Supreme Court in the case of the San Diego Land Co. vs. National City, (1898, 174 U. S. 739) in which the court says:

"One of the points in dispute involves the question whether the losses to the appellant arising from the distribution of water to the consumers outside of the city are to be considered in fixing the rates for consumers within the city. In our judgment the Circuit Court properly held that the defendant city

was not required to adjust rates for water furnished to it and to its inhabitants so as to compensate the plaintiff for any such losses. This is so clear that we deem it unnecessary to do more than to cite the conclusion reached by us on this point. If the municipality need not consider the losses on outside business, in fixing its rates, it surely follows that it cannot consider the profits on such business and make correspondingly lower rates. This proposition, it would seem, should rest on the well established principle that the state cannot consider intrastate profits and business in fixing interstate rates."

The whole problem is one of apportionment and accounting and it is submitted that even if possibly in simple cases municipalities have grappled successfully with it, the problem as a general principle, is emphatically one for the state, and not the municipality, to cope with successfully.

Theoretically it might be possible for the municipality acting separately to achieve results. The practical difficulties in the attempt of separate municipal units, rather than one powerful central body to correctly ascertain the necessary accounting facts with regard to a larger corporation conducting its business over an extensive area and in many municipalities, would be insurmountable.

It is not necessary to go into detail as to these difficulties. By way of illustration merely, the valuation and proper apportionment of an extensive electric lighting plant doing both power and lighting business, but with its chief generating plant in some other municipality—possibly a very substantial distance away—it suggested. Or, take the case of a comparatively small town receiving urban and interurban service from the same electric railway, light, gas or water plant.

Leaving problems of the foregoing nature, we find ourselves at once confronted with probably even more serious ones if the municipalities are to deal separately with the continually increasing extra-urban and interurban activities of public service companies. In the first place, in the absence of specially delegated power, the municipality, as already noted has no extra-territorial power. There are apparently a few cases in which this power has been granted and used, but the wisdom of such a course seems extremely questionable. This question of extra-territorial municipal power is perhaps as well discussed as anywhere in the California case, South Pasadena, vs. Terminal Railway Co., (1895, 109 California, 315.)

The City of South Pasadena granted a franchise to the defendant railway company for the use of its streets upon the condition among others, that round-trip fares between certain stations named within the city limits and the business center of the city of Los Angeles shall never exceed 30 cents. The court said:

"Here was a road lying partly within the confines of at least three municipalities, Los Angeles, South Pasadena and Pasadena; conceding the right of plaintiff to impose limitation on the charges to be made for passage between stations within its limits, and stations elsewhere, then the other cities named have or might have the same right; but suppose the city of Los Angeles, as a condition of the occupation of its streets by the railroad, had ordained that the round trip fare between stations within its limits and South Pasadena should be more or less than that fixed by the ordinance of the latter city, that is, that the fare to Pasadena, a place more remote than South Pasadena, should be less than that to the latter point as fixed by its own ordinance, is it not plain either that a conflict must arise and inevitable discrimination between the places ensue, expressly prohibited by the constitution, Article XII. Sec. 21, or that the railroad company must charge only the lowest of the rates thus fixed by jurisdiction of equal authority, and so the ordinance prescribing the lowest rate be made operative in and between both places? Similar illustrations of possible confusion might be multiplied indefinitely."

The principle laid down in that case applies to all interurban and suburban activities of public service companies whether steam railroads, electric interurbans and suburbans or the rural and long distance service of telephone companies. Taken from a slightly different standpoint, they also apply to some of the other public utilities.

The adjustment of the rights of various municipalities served by the same corporation and physical system most clearly require an impartial central agency which shall administer solely with an eye to the welfare of the whole territory involved and of the state itself. Such a policy is the only one which in the long run is really conducive to the common interests of all.

Another point which suggests itself is this: While, of course, every one will readily admit that there are many matter of a purely local nature over which the municipalities should have exclusive control, it is certainly highly undesirable that a municipality should have the power to block the most econome development of the various public service industries to the best advantage of the state as a whole. The state's interest in public service operations of that nature was pointed out in a comparatively recent Texas case, (City of Texarkana vs. Southwestern Telegraph and Telephone Co., 48 Texas Civil Appeals 16).

The facts as reported are not entirely clear, but apparently the city had acted arbitrarily in ordering the defendant to remove its poles and wires from the streets—not to underground them, but to withdraw entirely except for the long distance lines. The defendants had been furnishing telephones for public use and had duly obtained a permit from the

secretary of state. There appeared to be no evidence that it had acted unlawfully in any way. The court held the ordinance invalid. The following excerpt is taken from the opinion (page 22.):

"When we consider the nature of the business of telegraph and telephone lines in this busy commercial age, we have a most cogent reason for the legislature's declining to commit to the arbitrary control of the municipalities throughout the state the use by such companies of the public streets and alleys. These companies are not primarily of local concern, affecting only the inhabitants of the towns and cities through which they pass, but they essentially concern the public at large. * * * In other words, the business is such a one as calls for the exercise of state regulation rather than the delegated power of municipal control."

It is to the interest of the state as a whole that there should not be over-development in one locality and under-development in another. Ordinarily it is more economical, where possible, that new territory should be served by extensions from an existing plant rather than by the erection of an entirely new plant. In the electrical field, attention has already been called to the economy of large scale production and to the fact that as a practical proposition from the industrial standpoint, electric energy cannot be stored—in other words, must be used as produced—so that perhaps it could be said that the larger the plant and the closer between the maximum capacity of the plant and the demand at any time, the greater the economy.

It is almost impossible to conceive how the separate municipal units with their widely varying needs and conditions could achieve that continuity of policy and breadth of view necessary to successfully cope with these problems.

If the utility is municipally owned and has the power to supply beyond the municipal boundaries, the duty of making extensions, however necessary, to meet the requirements of suburban and interurban population, will always be dependent upon the attitude of the citizens of the municipality owning the utility. Objection to taxation necessary to meet such requirements will often prove an obstacle to the natural development of the utility. The economic desirability in cases of this nature of extensions rather than the erection of new plants, has already been noted. As a practical proposition, in such cases the only opportunity for obtaining the service would lie in extensions.

To consider another aspect of the regulation of public service companies. Many seem to think that municipal ownership is an adequate substitute for regulation. This belief, while possibly natural for those who have never given the subject much study or consideration, is a great mistake.

No municipality has been able to manage any business enterprise as successfully and economically as private persons or corporations. It is doubtful whether a single municipally owned utility, if operated under private management, would not render more efficient service and at an economy which would be sufficient in many cases to render a reasonable return upon the investment.

In the management of municipally owned utilities, employes, as a rule, are not engaged because of their qualifications, nor discharged because of their disqualifications. In the best managed munisipally owned and operated public utilities, you frequently will find a certain ulterior political influence dictating to the management who shall and who shall not be employed in the service.

For the past eight years, both privately and municipally owned plants have been under the control of the Railroad Commission of Wisconsin. Mr. Halford Erickson, chairman of the Wisconsin Commission, summarizes the result of his painstaking investigation of the conditions surrounding the operation of municipally owned utilities as follows:

(a) Municipal plants as a rule furnish poorer service than private owned or operated utilities. On the whole, it is on a lower level than that of the corporations.

(b) Municipal plants are slow in responding to new discoveries and improved methods and often fail to properly supervise their meters and other equipment.

(c) Discriminations in rates were as flagrant in municipal as in private plants.

(d) The low rates charged by municipal plants are not often due to the low cost of production, but largely, in one way or another, up-keep and other costs are shifted from the consumer as such to the taxpayer as such.

(C) Municipal plants are exceedingly backward in their methods of bookkeeping. In 1912, 161 out of 177 municipal plants in Wisconsin failed to keep their accounts in such a way as to disclose the true results of operation.

As an associate of Mr. Erickson for seven and a half years on the Wisconsin Commission, I can verify these statements.

If municipal plants are subject to all the accusations that have been made against private plants which are considered a justification for their regulation by public authorities, certainly municipal authorities are not competent to deal with the subject or regulation.

There is no form of human labor which cannot now be either greatly reduced or entirely eliminated by electricity.

Forget the tariff, the Mexican mixup and the financial policy. Attend to busines, and, lo, the business depression is a matter of history.

Electrification, of the Chicago, Milwaukee & St. Paul Railway Great Falls Terminal.

The Chicago, Milwaukee & St. Paul Railway has recently begun electrical operation of the terminal line in the city of Great Falls, Montana. This city is at present the terminal of the new 138-mile feeder line from Lewiston, Montana, connecting with the main line transcontinental division at Harlowton, the eastern terminus of the 3,000-volt electrification now under construction. The Great Falls terminal yards are located in the center of the city and are connected by a crosstown line, about 4 miles in length, known as the Valeria Way Line. There are about 3 miles of additional electrified trackage, making a total of 7 miles. The terminal buildings include a large freight house, round house, power plant and passenger station.

The tracks connecting the Falls Yards and the Terminal Yard pass through the business part of the city; and it is expected that considerable benefit will be derived from the elimination of steam locomotive smoke from the center of the city, as well as a reduction in the cost of train haulage. The traffic includes the transfer of both freight and passenger trains from the Fall Yards to the terminal station, as well as switching service in the terminals.

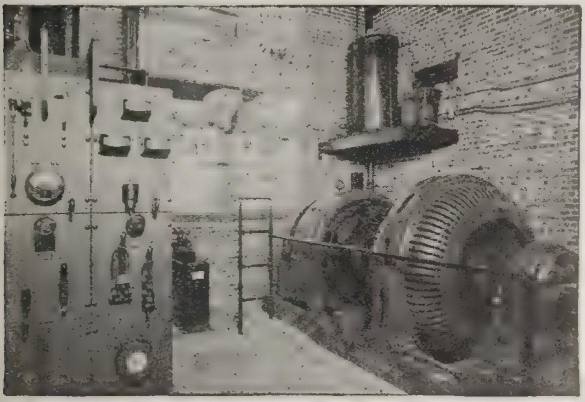


Fig. 1. 1500-Volt Sub-Station Equipment, Great Falls Electrification, Chicago, Milwaukee & St. Paul Railway.

The electrical equipment is of sufficient capacity to take care of 580-ton freight trains operating at about $9\frac{1}{2}$ m. p. hr. on the maximum grades of 0.65 per cent. Electric power is supplied by the Great Falls Power Company from the hydroelectric plant at Rainbow Falls, about 6 miles from the sub-station. Energy is transmitted at 6600 volts, 3 phase, 60 cycles as generated at the power station.

Substation.

The substation equipment is located in the power station operated by the railway company for heating the terminal buildings, and includes a 2-unit, synchronous motor-generator set with a two-panel switchboard for controlling the alternating and direct current units. The motor is rated 435 kv-a (0.8 power factor), 6600 volts, and operates at 900 r. p. m. Provision is made for starting as an induction motor through a compensator, which is operated from the alternating current panel. The generator is of the commutating pole type, rated 300 kw. at 1500 volts. The set is capable of carrying 200 per cent overload, or 900 kw. momentarily. Excitation for the alternating current motor fields and for the shunt fields of the direct current generator is furnished by a 10 kw., 125 volt, direct-connected exciter.

The switchboard consists of two natural black slate panels, one controlling the synchronous motor and the other the direct current generators and feeder. The direct current panel is a standard 1500 volt type, carrying remote control, hand-operated switch and circuit breaker mounted between slate barriers at the top of the panel. The motor panel contains the usual instruments and starting and operating switches for controlling the motor. An aluminum cell lightning arrester is also installed in the station as a protection against electrical storms.

Locomotive.

All trains are handled by a standard, 50-ton electric locomotive of the steeple cab type, designed for slow speed freight and switching service. The running gear consists of two swivel equalized trucks, carried on semi-elliptic equalizer springs. The driving wheels are of solid rolled steel, 36 in. diameter.

The motor equipment includes four GE-207, 750 volt, box frame, commutating pole motors insulated for 1500 volts. Each motor has a normal one hour rating of 79 hp. at 750 volts, and two motors are connected permanently in series. All motors are ventilated by a blower direct-connected to dynamotor in the cab of the locomotive. The gear reduction is 64/17.

The control equipment is Sprague General Electric Type M, arranged for operation from either end of the cab. There are ten steps with the motors in series and seven steps in series-parallel. Control current for operating the contactors, lighting and other auxiliary circuits is furnished by a Type CDM-19, 1500/600-volt dynamotor. A multivane fan carried on an extension of the shaft furnishes air for ventilating the motors.

Fig. 2. Type 404-E-100-4GE207-1500-Volt Electric Locomotive, Great Falls Electrification, Chicago, Milwaukee & St. Paul Railway.

The current collector is a sliding pantograph, similar to that being installed on the main line 3000-volt locomotives. The slider is lifted into position by air pressure and is held against the wire by steel coil springs. Provision is

made for operating at trolley heights varying from 17 to 25½ feet above the top of the rail.

Compressed air for operating the air brakes, whistles and sanders is supplied by two CP-29, 1500-volt, motor-driven air compressors. Each of these units has a displacement of 27 cu. ft. of air per minute at 90 lb. pressure. The compressors are located in the cab of the locomotive convenient for inspection.

Fig. 3. 50-Ton, 1500 Volt Electric Locomotive and Train, Great Falls Electrification, Chicago, Milwaukee & St. Paul Railway.

A headlight, provided with a concentrated filament type Mazda lamp of about 100 c. p., is mounted on each end of the locomotive.

As a safety precaution, no trolley wire is installed inside of the round house. A connection is made in the cab of the locomotive for applying power to the locomotive through a length of special flexible cable insulated for 2400 volts. A double-throw switch in the locomotive cab allows connection to be made either to the trolley or cable circuit.

Line Construction.

The overhead line construction is of the catenary type, similar in a general way to that installed on the Butte, Anaconda & Pacific 2400-volt railroad. Both span and bracket construction are used, depending on local conditions. Poles are spaced approximately 150 feet apart on tangent track, supporting a 4/10 grooved trolley from a 3-point suspension. There is no feeder copper installed.

Mercury Vapor Lamps Reversals

By J. A. Horton.

Mercury vapor lamps operate from direct current circuits and one condition of operation is that the end of the lamp be connected to the side of the circuit; otherwise the lamps will mirror and will eventually become useless. A mill operator using several hundred of these lamps was about to throw them out on account of the trouble they were giving. An electrician engaged in other work in the plant, heard of the matter and became interested. He ascertained that until the number of lamps had been practically doubled to meet the demands of mill extensions, the whole load had been carried by one generator; under this condition, operation had been entirely satisfactory. The greatly increased load was too much for the single generator, so a larger one was installed and it was the practice to use the larger generator when the load was heavy and the smaller one when the load was light. In making the shift from one to the other, they were thrown together momentarily. As there were no additional water-wheel connections available alongside of the older machine, the new one had been installed in a building at the other end of the plant and both tied to the same supply, as shown in the illustration. The dynamo tenders were several hundred feet apart, had no means of communicating with each other and there were no voltmeter facilities for bringing the incoming machine up to equal but opposite voltage before closing its line switch.

Assuming the smaller machine to be on the load and that it was to be replaced by the larger one, the regular method of doing so was about as follows: The time for making this change occurred at about the same hour each day. At this hour, the tender of the smaller machine would reduce its voltage by turning in the field rheostat. The tender of the larger or incoming machine, noting the line voltage decrease, would close his line switch with the incoming dynamo up to full voltage, thereby backing current through the smaller machine of reduced voltage. As both machines were compound-wound, this treatment of either tended to run the lower voltage machine as a motor and in the opposite direction of rotation. This tendency had never asserted itself any further than to cause brush sparking, because the tender was accustomed to pull his line switch the instant the rise in voltage enabled him to see that the incoming machine was on the line. But this action did not prevent the reversed current through the outgoing generator's series field from reversing its polarity. The reversal would not be noted at the time, but the smaller machine would start up next time with reversed polarity and, probably, would reverse the polarity of the larger machine. Thus were the polarities of the two machines reversed at intervals, so that sometimes polarity was correct or incorrect, the lamps were not being injured or were being injured.

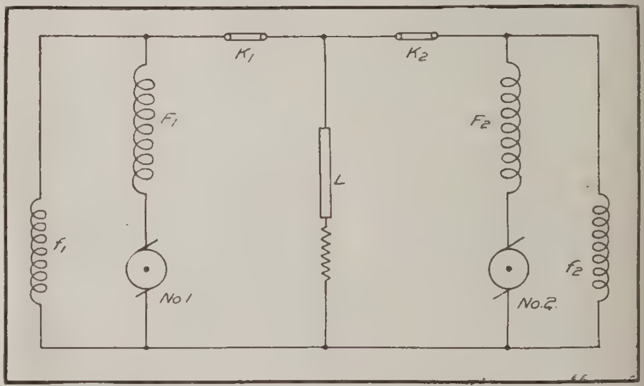


Diagram of Lamp and Generators.

To prove or to disprove the correctness of this diagnosis of the trouble, correct polarity of the large machine was insured, 25 new lamps installed and the total load carried on the big machine alone for a week: everything was all right. Voltmeter plugs and receptacles were then installed so that the two machines could be paralleled properly. All trouble was eliminated and this very efficient and satisfactory medium of illumination was allowed to remain.

Analysis of a Voltage Reduction in a 3-Phase Circuit

BY BERNHARD F. JAKOBSEN.

When changing over from a local supply system to a transmission line on one occasion, it was found that the voltage would be 2,400 volts instead of 2,200 volts as it had been before. The transmission line transformers were wound for 55,000/2,400 and it was not convenient to bring out a 2,200 volt tap from their windings. Besides it was considered an advantage to have the motor circuits supplied with 2,400 volts but the lighting circuit had to be lowered to 2,200 volts. The lighting load was 50 Kw., so that at 2,200 volts, the line current was $50 \div (\sqrt{3} \times 2.2) = 13.15$ amps. The voltage and current relations are shown in Fig. 1, in which ab, bc, ac are the three delta connected 2,400 volt secondaries of the transmission line transformers, and $E'ab$, $E'bc$ *and* $E'ac$ are the three transformer voltages. The transformers marked a', b' and c' are three small transformers connected as shown in order to lower the voltages in the lighting circuit, and the voltages in the lighting circuit are E'_1, E'_2 *and* E'_3. The currents need not be considered here.

The arrows in Fig. 1 indicate those directions, which

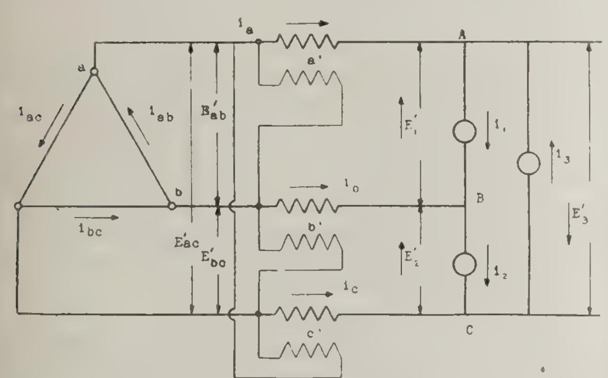


FIG. 1. VOLTAGE AND CURRENT RELATIONS IN CIRCUITS CONSIDERED.

in the following calculations will be considered as positive. These arrows do not show actual currents flowing at any instance or actual directions of voltages at any instance, since some of these are bound to be negative. Fig. 2 shows the relation of simultaneous currents (or emf's) in the small transformers. The lowering of the voltage, as already stated is affected by means of the three small transformers. This could not be done by resistances or reactances, since that would cause high voltages at small loads and vice versa, or rather the opposite of what was desired. Three small 2 Kva. 2,200/120 volt transformers were available. The line currents are 13.15 amperes and the transformers must therefore have a capacity of at least 13.15×120 volts or 1.575 Kva. These two Kva. transformers are therefore large enough.

In Fig. 3, let E' be a vector (a voltage for instance) and let the projection upon the vertical axis (the j-axis) be designated (je) and be positive if it falls above the horizontal axis and negative if it falls below it. The projection upon the plus one axis constitutes the other component of the vector E'. By thus multiplying the vertical projections of any vector by $j \div \sqrt{-1}$ the vertical and horizontal components can always be distinguished from each other. In connection with the following calculations, it is immaterial what (j) stands for. The vertical projection of a vector is also its instantaneous value. The following relations are then evident from Fig. 3:

$j E \sin\phi = je$; $E \cos\phi = e'$; $E' = E\ (j \sin\phi \cdot + \cos\phi) = je + e'$

$E = \sqrt{(e^2 + e')}$; $tg\phi = e \div e'$ ....(1)

E^1 represents the vector both as to quantity and phase (location in the diagram with reference to the axis), but E represents only the quantity. When E is the maximum value of an alternating current voltage, then $E\sin\phi$ is the instantaneous value, and when the angle ϕ is $2\pi fxt$, (f) being the frequency and (t) the time in seconds from the moment when the instantaneous value was zero. $E \div \sqrt{2}$ is when the instantaneous value was zero. E and E^1 have necessarily the same length in the same diagram. In the following the angle ϕ will be considered as constant, since it is the relation of the various vectors which are of interest and not their instantaneous values. In Figs. 1 and 4, E'_{ab} is the transformer voltage both as to quantity and phase; E^1a^1 is the voltage of the small transformer (a') or the voltage difference between the points (a) and (A). E'_1 is the voltage of the lighting circuit in phase AB, etc., for the other voltages shown.

From Fig. 1 is seen, that when the instantaneous value of E'_1 or je^1 is positive, then the current i^1 is positive; i_b is negative and i_{ab} and i_a are positive, these being the instantaneous current values in the circuits indicated in the figure. Consequently; starting from point B:—

$E'_1 = -E'_b + E'_{ab} + E^1_a$ ....(2)

That is to say, if $E'b'$ (or rather its instantaneous value), is positive, it will decrease the instantaneous value of E'_1. Now, if (n) be the ratio of transformation for the small transformers, then,

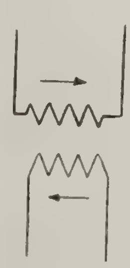


Fig. 2.

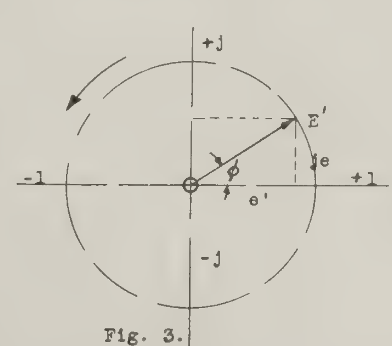


Fig. 3.

FIG. 2. RELATION OF SIMULTANEOUS CURRENTS IN TRANSFORMERS. FIG. 3. VECTOR PROJECTIONS.

$E'b' = -E'_{bc} \div n$ ....(3)

That is, if the instantaneous value of E'_{bc} is positive, the voltage of the transformer (b') being directed against it, the instantaneous value of the voltage $E'b'$ is negative. Likewise,

$E'a' = - E'_{ab} \div n$; and $E'c' = -E'_{ac} \div n$..(4)

Introducing the values from (3) and (4) into (2):—

$E'_1 = E'_{bc} \div n + E'_{ab} - E'_{ab} \div n$, and likewise,

$E'_2 = E'_{ac} \div n - E'_{bc} - E'_{bc} \div n$, and,

$E'_3 = E'_{ab} \div n - E' - E'_{ac} \div n$ and also

$E'_3 = - E'_1 - E'_{2\,ac} - E'$

$E'_3 = - E'_1 - E'_2$

Using the effective values of voltages instead of the maximum values in what follows (to avoid multiplying by $\sqrt{2}$), E_{ab} is 2,400 volts and E'_{ab} lies along the plus one axis, so that,

$E'_{ab} = E_{ab}$ (jsin 0° + cos 0°) = $jeab + e'ab' - Eab'$ = 2,400 volts.

E'_{bc} makes an angle of 120 degrees with the plus one axis, therefore,

$E'_{bc} = E_{bc}$ (jsin 120° + cos 120°) = $jebc + e'bc$ = 2,400 [(j$\sqrt{3} \div 2$) — 0.5] = 2078j — 1200;

E'_{ac} makes an angle of 240 degrees with the plus one axis, so that,

E'_{ac} =E ac (jsin 240° + cos 240°) = — 2078j — 1200, and as a check:

$E'ab + E'bc + E'ac = 0$

The ratio of transformation of the small transformers is 2200/120 or 18.35; then from equation (5):

E^1_1 = 2078j/18.35 — 1200/18.35 + 2400 — 2400/18.35 — 113.1j + 2203.8, and

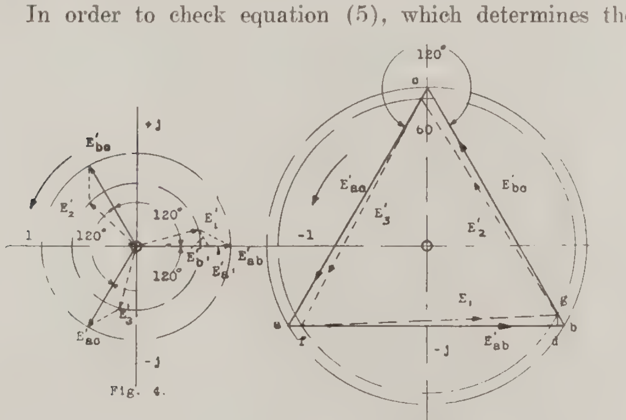
E_1 = 2206.7 volts, since $\sqrt{a^2 + b^2} = a + b^2/2\,a$ if (a) is large compared with b, as in this case.

E_1bc — 2078j/18.35 — 1200/18.35 + 2078 j — 1200 — 2078j/18.35 + 1200/18.35 = 1851j — 1200 and E_2 = 2206.6 volts.

E^1_3 = — 113.1j — 2203.8 — 1851.8j + 200 = — 1964.9j — 1003.8 and E_3 = 2206.5 volts.

The three voltages are of course alike. For E^1_1, when ϕ is the angle which this vector makes with the horizontal, tgϕ = 113.1/2203.8 or ϕ = 2° — 56′ — 33″, that is, the voltage E^1_1 leads the transformer voltage E^1ab; and the same holds good for the other voltages. This is shown in Fig. 4, which, however, is not to scale.

In order to check equation (5), which determines the



Figs. 4 and 5. Vector Relations for Reduced Voltages.

relation between the transformer voltages and the load voltages (E^1_1, E^1_2 and E^1_3), it is best to assume different instantaneous values for the voltages and make sure, that (5) holds good for these different values. For instance, when in Fig. 4 the instantaneous value of E^1ab is zero, or eab = O, then from Fig. 1, since ebc is positive at this instant and eb^1, therefore negative, the voltage increases when going from point (B) through transformer (b^1) to (b), or since eab = O, the potential at point (A) is at this instant higher than at point B, or e_1 is positive; therefore the projection upon the vertical axis of the vector E^1_1 in Fig. 4, should lie above the horizontal, as it also does. In Fig. (4a) the vectors are shown at a later period, when eab and ebc are both positive and shortly after eac has reached its negative maximum. Now from Fig. 1. it is seen, that transformer (b^1) at this instance tends to raise the voltage of point (A) with reference to point (B) and therefore tends to increase the voltage E_1 the transformer voltage Eab being given. Transformer (a^1) on the other hand at this instance tends to lower the voltage of point (A) with reference to point (B) and therefore tends to lower e_1, since e_1 is positive, when the voltage at point

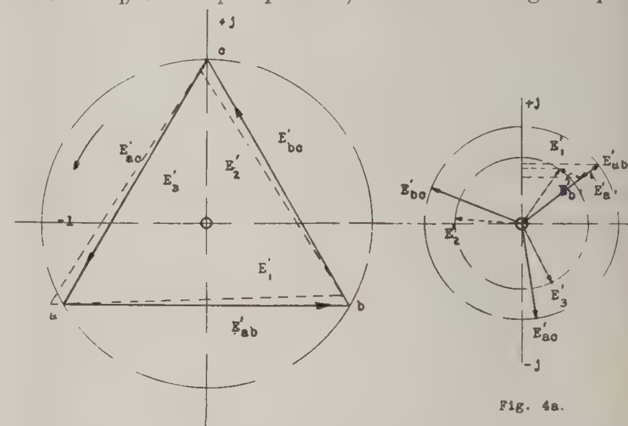


Fig. 4a and 6. Vector Relations with Vector Voltages Taken at Later Period than in Fig. 4.

(A) exceeds the voltage at point (B). This is also plainly seen in Fig. 4a, where the projection of E^1ab is diminished by the projection of E^1a^1 and then augmented by the projection of E^1b^1, in order to give the projection of E^1_1, or as in (5):

$$E_1 = E'\,ab - E^1ab/n + E^1bs/n$$

GRAPHICAL SOLUTION.

As indicated in Figs. 4 and 4a, the values of E^1_1 may be found by introducing E^1a', and E^1b^1, as shown in those figures.

Fig. 5, however, is better adapted to represent a delta connected circuit. Here the voltages are positive, when their projections in the direction of the arrows upon the vertical axis point upward and negative, when they point downward, so that, in the figure, the instantaneous value of of E^1bc is positive, while the instantaneous value of E^1ac is negative, just as in Fig. 4. Whenever E^1ab in Fig. 5 has a vertical projection pointing upward, the voltage of point (a) in Fig. 1 exceeds that of point (b).

In Fig. 5, the voltage E^1ab = ab is to be decreased by E^1a' = af, leaving the voltage (fb) in Fig. 5, as the voltage between the points (A) and (b) in Fig. 1. Likewise (bc) in Fig. 5 is diminished by (gb) = $E^1\,b'$ and the voltage E^1_1 = (fg) results.

Therefore: af = Ea' = Eb' = Ec' = 2400/18.35 = 130.8 volts;

db = 130.8/2 = 65.4 volts, so that,

$e'ab$ =2400 — 130.8 — 65.4 = 2203.8 volts.

and gd = ($\sqrt{3}$ × 130.8) ÷ 2 = 113.1 volts, and,

E^1_1 = 113.1j + 2203.8, as found above.

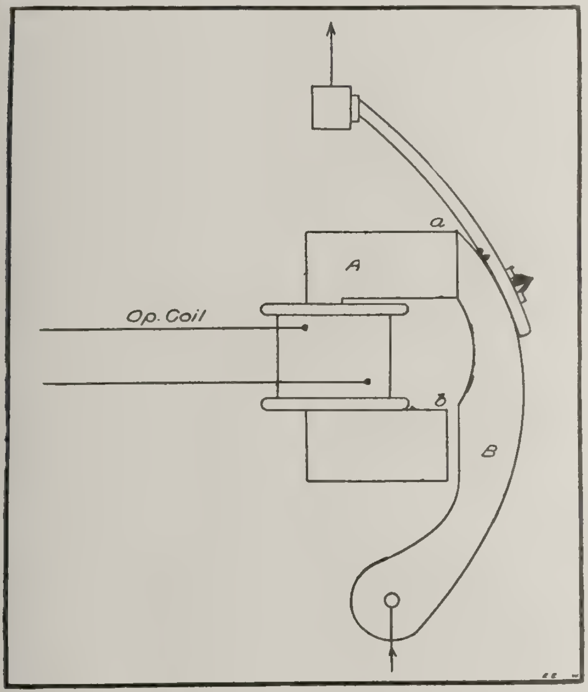
In Fig. 6 is shown the voltage relations that result, when transformer (b') is reversed.

Installation, Operation and Maintenance

This section is devoted to practical suggestions, experience and data, and is open to all readers who have something to say on every day work and trouble in the plant or sub-station, on the line, in the factory, mill or elsewhere.

Adjustment of Contactor Air Gaps.

The current which any alternating current electromagnet will take, depends largely upon the nature of the magnetic circuit to be energized by the coil. With a closed magnetic circuit the self-induction is very high and the current taken may be very small. If the magnetic circuit includes an air gap, the increased reluctance will decrease the inductance and the counter *emf* and the current admitted will be heavier. On alternating current electromagnets such as used for contactors, the air gap is necessarily variable in length, being long when the contactor is open and short when it is closed. Therefore alternating current contactor operating coils take much heavier current when the contactor is open than when it is closed. This means practically that if an alternating current contactor gets stuck open, the coil will be burned out if the irregularity is not discovered in time to prevent it.



TROUBLE WITH CONTACTOR AIR GAPS.

The accompanying sketch gives the general scheme of a contactor. The magnetic circuit includes two air gaps *a* and *b* between the core and the movable armature. When the contactor is closed as indicated in the diagram, break *a* is entirely closed but the other *b* is designed to remain slightly open. This is to prevent residual magnetism from holding the contactor closed after the current through its operating coil has been interrupted. On one occasion an operator needed another contactor, so he used one that he had as a guide and made another himself. His home made device worked alright but his operating coil would roast out in about a month. After he had roasted two coils, he suspected the cause of the trouble and checked his dimensions. Air gap *b* was 1-16 inch too thick. He remedied this by filing down at *a*.

Effective Resistance and Inductance of Iron and Bimetallic Wire.

When a direct current flows in a wire, the distribution of the current is uniform over the cross-section of the conductor. When, however, an alternating current flows in a wire there is a tendency for the current to crowd to the outside. This phenomenon which is caused by differences, in the opposition to the current flow in different parts of the conductor, becomes more pronounced the greater the number of alternations of the current in a given time and, in iron wires, the greater the current in the wire. In some cases the flow of current is confined almost entirely to a thin shell on the outside of the wire and hence arises the term "skin effect" for this phenomenon. The effective resistance of the conductor increases as the frequency of the alternations increases and at the same time the inductance, which depends upon the magnetic field, is diminished. This effect is not only of interest from a purely scientific standpoint, but is frequently of importance in engineering practice.

When the conductor is of simple form and the magnetic permeability of the material is known, the effective resistance and inductance can be calculated by formulas which have been developed. The investigation, the results of which have just been published by the Bureau of Standards, Department of Commerce, in Scientific Paper No. 252, was concerned with the skin effect in conductors containing iron. Two classes of conductors were considered in particular; the iron telegraph and telephone wires and copper clad bimetallic wires. The latter have a core of steel surrounded by a shell of copper. The effective resistances and inductances of these conductors were determined experimentally for different strengths of current and for frequencies up to 3,000 alternations per second. The results for iron wires obtained with very small currents were compared with values computed by known formulas and the agreement is fairly satisfactory. Formulas are developed in this paper which permit a similar comparison between measured and computed values for the copper clad wires. The paper concludes with wire tables computed by means of the new formulas. In these tables the effective resistances and inductances of copper clad wires are given for wires of different sizes and conductivities and for frequencies up to 3,000 alternations per second.

Interested parties may secure copies of this pamphlet free of charge by applying to Bureau of Standards, Washington, D. C.

Suggestions Relating to Conduit Installation.

By Chas. C. Evers.

More complicated methods can be adopted for figuring prices but the result given by the method suggested above is sufficiently accurate for the work of an average character. Where the job to be installed is of an unusual nature, the only safe basis on which to compile an estimate is to make a detailed schedule of the cost of the material required and then add an allowance for labor. This labor allowance is usually most conveniently made on a unit basis, that is, the estimator knows that it will cost a certain price a foot to erect a given sized conduit, a certain price per foot to pull the wire into the conduit, and that the price for mounting one ceiling outlet will be a certain figure. From his note-book, which should contain a complete table of unit prices, he should proceed through his list of materials and by making a suitable labor price allowance on each item of material, can readily obtain the total labor cost.

It will probably be of interest to the practical reader to know how the price estimate was made for the proposal covering the work in the flats shown in Fig. 12. The figuring was done on the convenient and reasonably accurate "unit price per outlet" method. Here is a complete summary of the figuring necessary:

36 Switch Outlets	@ $2.50—	$ 90.00
42 Bracket Outlets	" 2.25—	94.50
18 Bracket Outlets	" 1.00—	18.00
66 Ceiling Outlets	" 1.80—	118.80
1 Porch Outlet	" 2.00—	2.00
1 Basement Outlet	" 2.50—	2.50
Total		$325.80
Bell Work		5.20
		$331.00

This gives an average price per outlet of $2.02. In the particular case illustrated, the six flats in the building required a total of 17 one-man days to complete the work of wiring. This work comprised a total of 13 one-man days for erecting the conduit and rough bell work, that is, for roughing in, and 4 days were necessary for pulling in the conductors and mounting the switches, bells and buttons, and connecting up the job.

Another economical layout for conduit wiring is shown in Fig. 13, which illustrates how the conduits were installed in a two-story flat. These runs were carefully planned before any actual work was done, with the result that the labor and material required were both maintained at a minimum.

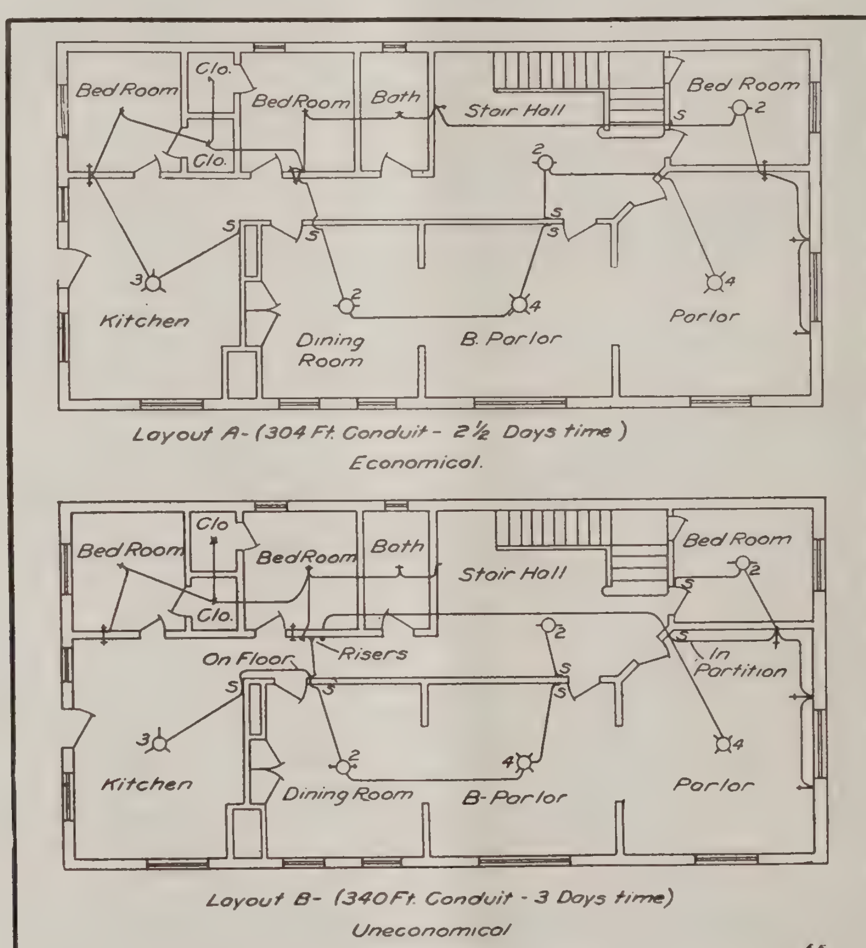


Fig. 12. Wasteful and Efficient Conduit Layouts.

Frequently in wiring finished buildings it is desirable to use flexible metallic conduit for as many of the runs as possible because of the ease with which this material can be installed in that it requires no elbows or threading, and can be frequently fished in a partition from the attic of a building to the basement. However, the use of flexible conduit is prohibited by the Underwriters in places that are damp or tend to be damp. In other words, it should not be applied around water tanks, pumps, water pipes, in bath rooms, or in damp cellars. If damp places exist in any particular job, this fact need not deter the wireman from using flexible conduit for the majority of his runs. He can as shown, use flexible conduit for the major part of a run, and then attach to it with the connectors that are made for the purpose, lengths of rigid conduit in the places that are damp. Such an application is shown in Fig. 14, where rigid conduit was used in the tank room on the roof of the building, and in the pump room in the basement, and flexible conduit installed for the balance of the run.

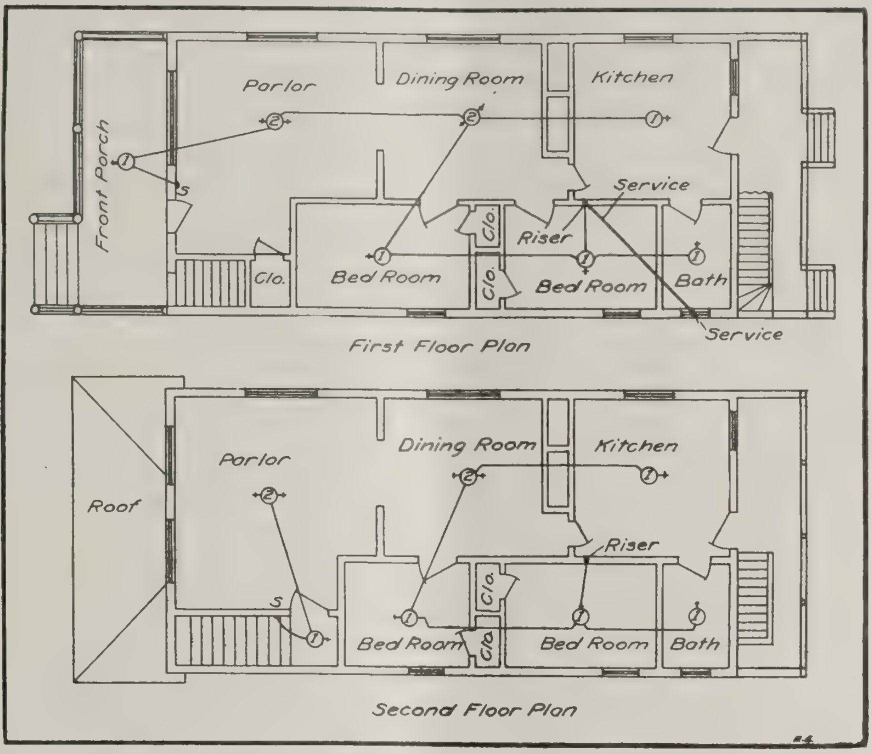


Fig. 13. An Economical Layout for a Two-Story Flat.

The Underwriters' rules require the use of double-braided rubber-covered wire for conduit work, but permit single-braided rubber-covered wire for concealed work that is not in conduit. These rulings have made it necessary in the past for the contractor to carry in stock rubber-covered wire of two grades. He has had to carry single-braided and also double-braided conductors. Recent investigations have indicated that in spite of the fact that the double-braided is a trifle the more expensive, it is altogether probable that it would be economical in the long run to stock only double-braided conductors, and to use them for the situations that are now wired with the single-braided material. The Underwriters of course approve of the use of double-braided conductors wh~~e single-braided conductors are permitted. As a rule, only the smaller buildings have been wired by the moulding or knob and tube systems, with single-braided wire, and it has been estimated that the increase in cost due to the substitution of double-braided for single-braided wire amounts to probably not more than $1.00 for the average small building. In view of this, there will doubtelss be a movement in favor of double-braided wire for all work where rubber-covered wire is necessary. It is believed that if the average contractor who does both conduit and knob and tube work will consider the situation he will find that it would now be economy for him to use double-braided wire exclusively, thereby reducing his rubber-covered wire stock to one grade instead of the two.

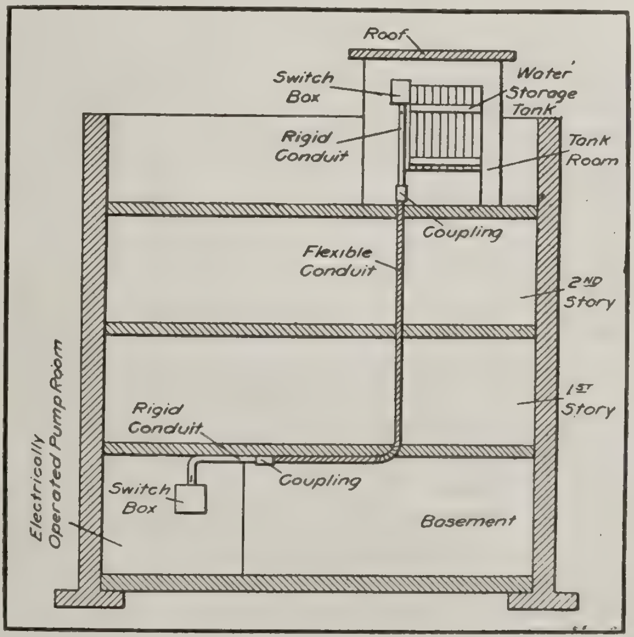


Fig. 14. Combination of Rigid and Flexible Conduit.

An Overloaded Governor.

By A. J. Tonor.

Some of us may be keenly solicitous as to whether our generator or our motor is overloaded and yet entirely overlook the matter of capacity of auxiliary devices or of wiring upon which the successful operation of the generator or of the motor may depend. Especially likely is this condition to obtain where a larger unit is substituted for a smaller unit. In the natural order of things, the Underwriters' requirements are a saving feature when observed, but unfortunately, these requirements very often are not observed.

As an example, railway men increased the sizes of their motors and the weights of their cars, long before they paid any attention to the sizes of the car wiring used and with the result that when the motors were drawing full rated current, as on up-grades, the wires were consuming a large percentage of the total voltage available. As another and a more recent example, an operator called an inspector to find out why the safety valve on his air tank was blowing so continuously. The inspector found two three-phase induction motors applied to compressors used for storing air in a tank, the air pressure of which was regulated by means of a small governor which actuated directly the contacts that opened and closed the motor circuit accordingly as the pressure was maximum or minimum. These contacts were welded together. This kept the motor circuit closed so that the motor operated continuously. The governor originally had been installed to control the load of but one motor. To increase the amount of air available the operator had added a motor and a tank, but nothing else. The governor contacts were unable to handle the overload current of two motors and the contacts finally heated so that they welded together. The situation was relieved by installing an external contactor with the governor.

Non-Reversible Motor Reversed.

By J. A. Horton.

The rotation of all repulsion-induction motors is reversible, but only those motors that are to be applied to reversing duty are arranged therefor. The direction of rotation of reversible repulsion induction motors is affected either by means of a reversing field or by means of a brush-shifting device that shifts the energy brushes to one side or the other of the neutral position; in either case the net result is directive force due to a component of the energy field. An operator of a book bindery complained that sometimes, in throwing the starter to the off position, to stop the motor, the motor would stop, but would immediately start in the opposite direction.

The reason for this can be seen by referring to the accompanying diagram. The motor brushes are there shown in neutral, in which position the motor cannot start in either direction. With the brushes in this position the motor will get no current provided the operating cable connections have been so adjusted that the starter is in its central or off position; then the neutral indicating marks on the brush holder and on the bearing housing, coincide. Movement of the starter to the right, causes the brush holders to revolve counter clockwise, and if the operating cable is connected to the correct point *a* of the starting handle, when the starter reaches the dotted position *c*, the brushes will have reached their position of maximum speed ahead. On restoring the starter to off position, springs return the brushes to neutral position and simultaneously, the starter interrupts the current; if, however, due to want of adjustment of the operating cable by means of its turnbuckle, the cable be allowed to get too long, the spring *s* will pull the brush holders past neutral and to their reverse position before the starter handle reaches the position in which it interrupts the current. This was the cause of the trouble in question: adjustment by means of the turnbuckle stopped the holders at neutral simultaneously with the interruption of the current by the starter handle.

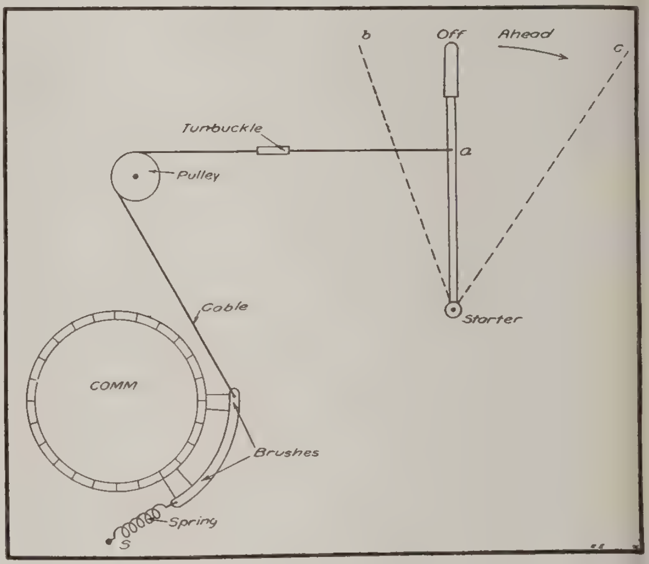


Diagram of Motor Starter.

Armature and Commutator Troubles.

Discussion of Mr. Knapp's Article.

L. Thompson.

I have read Mr. Knapp's articles with much interest; my work for several years has been along similar lines, therefore, I am taking the liberty of emphasizing the important points, adding a little to some, and trying to make others clearer.

Among the list of causes for sparking, is the short circuit. As so much is possible in electricity, I will not say that this is untrue, but I have not seen, in 12 years, a single case where it did cause sparking.

When under-cutting commutators by hand I use first a three cornered file to cut the mica below the surface of the copper; then use a back-saw blade which has had the sides of the teeth ground off, so that it will go down between the bars. By breaking off the end of the blade and holding the large piece in a hand vice, the mica can be quickly cut to the required depth.

In the 6th paragraph the statement is made that "the machine attains its working temperature, the copper expands, and the commutator becomes loose." From this statement one is apt to infer that it is the expansion of the copper that causes the commutator to become loose. The commutator does get warm, and the copper expands, but the expansion of the copper is much more than the iron shell that is holding it, therefore, this expansion tends to tighten the commutator and not to loosen it.

When the mica rings are cut they are only slightly flexible due to the shellac in it; hence they cannot be made to fit perfectly when cold. Now, when the commutator is hot the shellac in the mica will soften and allow it to move under the strain of the centrifugal force of the bar when the machine is running, which is not present when the machine is standing still. It is this movement of the mica that allows the bars to move, assuming that the mica rings are of uniform thickness.

In the 8th paragraph on oil on the commutator, this statement is made: "This gradually deteriorates the mica and causes current to leak from one bar to the other, with the result that the mica becomes carbonized, and a short circuit results." It is a fact that oil is one of the best insulators known. It is not the presence of the oil that causes the trouble, but it is the carbon and copper dust collecting in the oil that causes the trouble.

Mr. Knapp clearly states that before opening a commutator it should be thoroughly blown out with compressed air in order to remove all dust that may have accumulated. I want to emphasize this bit of warning, for I well remember the time when I failed to give a large commutator a blowing out before opening it. In order to remove the very fine carbon dust from the inside of the commutator, which had fallen in, it was necessary to take all of the mica from between the bars. This was a slow and difficult job that should have been avoided.

The remarks in regard to heating the commutator and the mica are also worth consideration. By the application of a little heat the shellac is softened, allowing the end rings to be removed when they would otherwise be broken.

Making Our Question and Answer Columns More Valuable.

A suggestion has come from one of our correspondents, Mr. R. H. Willard, that the readers of our Question and Answer columns can get more out of them if there is a thorough interchange of opinions on all subjects discussed. That is, after all answers to a question have been published, the matter might still be a little clouded and obscure. In that case, questions asking for further light would bring out the lacking information.

Again, a discussion of a problem is generally interesting. When several men interested in a common subject foregather, they pass many pleasant hours discussing different problems and exchanging their various views. When they disperse, it is with a feeling of time having been interestingly and well spent.

Our readers are scattered in all parts of the country, so it is physically impossible to meet and hold those delightful social sessions. Why not, then, make this department a mental meeting place where all can gather on a common level? If the views expressed by one correspondent do not harmonize with your own knowledge and experience, let us have your view of the matter, and we will all benefit thereby.

But remember this is to be a social gathering. If we were meeting face-to-face we would be considerate of the feelings of one another, and say nothing to injure those feelings just because we differed from a speaker in our views. Let us adopt the same policy in our "absent meetings," and while we might differ from one another in the opinions we express, do so in a helpful, cheerful, kindly spirit of comradeship, at which none can take offense.

The letter which called forth these remarks is herewith reproduced.

More Discussion.

"For some time past the writer has been interested in the Question and Answer section and has received many valuable pointers from it; but it is his belief that all of us would get more benefit from this section if more of the answers were discussed. If an answer is given which does not agree with our understanding of the matter, lets discuss it, not in a spirit of criticism, but with a view to bringing out the correct answer. Many of us are in a position where we cannot talk over these points which trouble us with others who understand them, so let's talk with each other not *at* each other in this section. In this way we may be able to correct false ideas we have on various questions and will at least get some different points of view."

R. H. Willard.

Electrical Materials in Siam.

Electrical materials and apparatus are not manufactured in Siam, hence materials for renewals and extensions of all electrical enterprises, electric street railway equipment, lighting fixtures, telephone apparatus, cables, insulators, electric motors, fans, batteries, bells, cooking utensils, sadirons and a variety of similar goods should be in demand. The possibilities of extending American trade in electrical materials and apparatus might be enhanced by arranging for an exhibit of such goods in Bangkok; also by American firms entering into correspondence with local consumers as to their requirements, by submitting price lists, and by appointing local agents. Agents should be supplied with samples of materials and prices for supplies needed by the Government telegraphs, telephones, and power stations, as all such goods are bought through public tenders and the time allowed is frequently not sufficient to permit bids to be submitted from American firms direct.

Sales Methods in Argentina.

The Sociedad de Electricidad de Rosario (light and power plant), in an effort to increase consumption of current at Rosario, particularly during those hours when consumption is ordinarily smallest, has rented a large store on one of the principal business streets and there installed electric fans, drying apparatus, toasters, sadirons, curling irons, tea and coffee pots and other kitchen utensils, cigar lighters, stoves, motors for sewing machines, laundry machines, etc. While the company does not aim to sell apparatus or appliances, it may eventually carry a small stock of articles that local firms do not handle. When business picks up again the activities of the Sociedad de Electricidad may be expected to lead to an increased demand for electric appliances and supplies at Rosario.

Questions and Answers from Readers

Readers are invited to make liberal use of this department for discussing questions, obtaining information, opinions or experiences from other readers. Discussions and criticisms on answers to questions are solicited. However, editors are not responsible for correctness of statements of opinion or fact in discussions. All published answers and discussions are paid for

QUESTIONS.

Cost of Depreciation Curves.

Editor Electrical Engineering:

(539) Will some of your readers kindly advise me through the Question and Answer columns the cost of securing a set of depreciation curves on transmission, distribution, motor, generator and power plant apparatus?

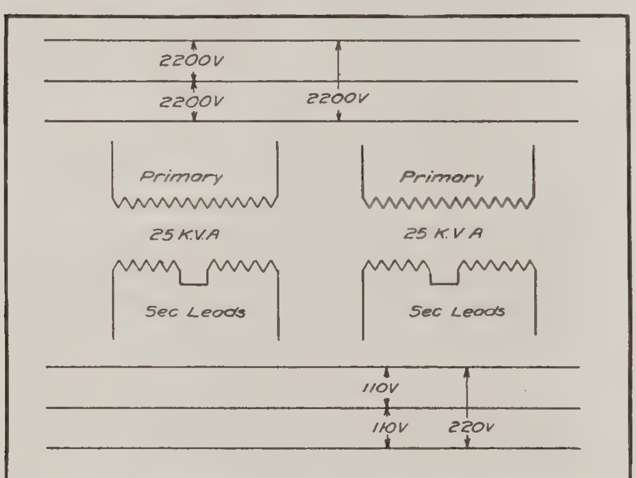
J. S. C.

Information on Transfers and Circuits.

Editor Electrical Engineering:

(540) You will find enclosed a sketch of transfers and circuits for which I wish information.

I have a three-wire 3-phase 220 volt circuit and two single phase transformers.



Sketch Showing Tranfers and Circuits.

I wish to connect the primary (3 wires) to transformers so as to balance the load and also get 110 and 220 from three wires on secondary.

If it is possible to do this, please give me sketch.

C. H. H.

Sparking Dynamo.

Editor Electrical Engineering:

(541) There is a small D. C. dynamo 60 V., 50 A or 3 Kw. in this town furnishing current for a moving picture show. The other night it was sparking badly at the brushes. The sparks were blue, and when the dynamo was shut down the commutator was found to be rough and pitted. As far as the writer can find out, it is a 4-pole shunt wound dynamo. Will some of the readers of *Electrical Engineering* tell me what caused that commutator to pit, and explain how to fix it again?

J. S.

Drop in Voltage.

Editor Electrical Engineering:

(542) I would like to have some of your readers tell me what drop in voltage there would be in 90 feet of No. 6 stranded wire carrying a D. C. current of 45 amperes at 45 volts.

S. J.

Winding an A. C. Armature.

Editor Electrical Engineering:

(543) I would like to see a diagram of an A. C. armature, a single-phase preferred. And please explain how it is wound and how every connection is made. J. M. K.

Difference of Potential.

Editor Electrical Engineering:

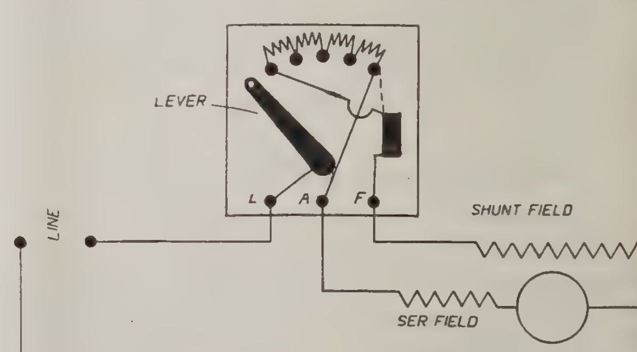
(544) Why is there a difference of potential between the conductors of a three-phase system completely insulated from ground, and how may this potential difference be calculated? One of our men received a shock from a 60,000 volt delta transmission line when standing on the ground; what voltage did he receive?

G. D. K.

Wiring for Compound Motor.

Editor Electrical Engineering:

(545) Please advise me if this diagram for a compound motor is correct, and what difference does it make



Connection for Compound Motor.

if I take the connection from the no voltage release and put it on the last point of the resistance coil per dotted line?

Flasher for Electric Sign.

Editor Electrical Engineering:

(546) I wish to build a flasher for an electric sign of drum-type construction:

First flash to remain on 5 seconds;

Second flash to remain on 3 seconds;

Third flash to remain on 10 seconds;

All off 4 seconds.

I would like a rule to find the length of each contact (in circumference) that each flash requires, also the size of drum in circumference and the speed required to keep the switches on contacts for the right periods.

I notice that each manufacturer sends a certain size pulley with their motors. One, for instance, has a 1/2-inch and another a 1-inch pulley, but both are marked 1800 revolutions per minute. Will revolutions of flasher be the same by using same size pulley on flasher in each case?

K. W. H.

ANSWERS.

Discussion on Induction Motor Operations. Ans. 502.

Editor Electrical Engineering:

In speaking of induction motors on over voltage, a statement is made which is misleading. "As long as the rated current is not exceeded the motor will not overheat." This is true of the heating in the windings and in this case, probably true of the whole motor as the over voltage is small. However, heating of the iron does increase as the voltage increases. This may or may not be harmful, depending on the design of the motor and on whether the iron was already running hot on normal voltage. In the case mentioned no serious over heating will probably result, as most manufacturers guarantee their motors for 10 per cent voltage variations.

The Steinmetz formula referred to for maximum output probably refers to momentary peaks which last for so short a time that heating is not the determining factor, but the maximum torque of the motor. R. H. Willard.

Selection of Insulators, Ans. Ques. No. 524.

Editor Electrical Engineering:

The main features to investigate in selecting an insulator are the dielectric and mechanical strength, and leakage and arcing paths and distanes and the ease of erection. These characteristics considered in connection with the unit cost form the basis of selection. The ratio of flash-over to puncture voltage should be in the neighborhood of 2.0. The leakage and arcing distances should be as great as is consistent in insulator design. Another consideration in selecting insulators of 22,000 volt service and over is the advisability of using a pin type insulator or the suspension type. The pin type is used up to about 60,000 volts while the suspension type may be added to indefinitely.

Henry A. Cozzens, Jr.

Voltage Between Wires and Ground, Ans. Ques. 526.

Editor Electrical Engineering:

Under normal conditions the voltage between line wires and ground is the same whether the neutral is grounded or not, and is equal to $60{,}000 \div \sqrt{3}$, or 35,000 volts. This difference is that with an ungrounded neutral this is a "static" voltage, *i. e.*, it exists only as long as there is no conducting path from line to ground, and if such path be established no current will continue to flow. With a grounded neutral the voltage from line to ground is a stable voltage which will send current through any conducting path which is offered. This stability of the voltage between lines and ground is one of the advantages of a grounded neutral. In either system the line insulation is subjected to a stress of $60{,}000 \div \sqrt{3}$ volts under normal conditions, but with an underground neutral, if one line become accidentally grounded the insulation stress on the other lines rises to 60,000, which is 1.7 times normal. With a grounded neutral an accidental ground on one line does not increase the insulation stress, but it causes a short circuit which will open the circuit breakers and give notice of the trouble.

R. H. Willard.

Three-Phase, 4-Wire Circuit, Ans. Ques. No. 528.

Editor Electrical Engineering:

In this discussion it is presumed that distributing circuits are understood, and by this means the question of potential strains, surges, etc., do not require consideration.

For serving a balanced three-phase load the four-wire circuit has no advantage over the circuit employing three wires, but has the disadvantage of having an additional wire, which may be most objectionable in those cases where a line traverses a thickly wooded country. On the other hand, the four-wire circuit has an immense advantage over the three-wire circuit where mixed loads—that is, loads of power and lighting, single-phase and three-phase loads—are taken off the same circuit, and the single-phase loads are of a capacity comparable to the three-phase.

With the four-wire circuit the three-phase loads are supplied from transformers connected either star-star or star-delta, that is, connected between phases; while the single-phase loads are taken off between the phases and fourth conductor. This arrangement enables transformers wound for one standard voltage to be used. With balanced load the fourth wire is not required, but it is used under unbalanced conditions. It also acts as the return for the exciting current of the transformers connected between phases and the fourth wire, or neutral, as it is called. This exciting current is the numerical sum of the exciting currents of all the transformers, since the triple frequency current flowing in the phases of the three-phase system are in phase with one another. It can be seen that each phase is really a circuit in itself, and is independent of the other two phases.

The four-wire circuit is the most flexible system there is for the distribution of mixed loads of power and lighting. Each phase is virtually a separate circuit, and as such is usually treated. By installing regulators in the individual phases it is possible to regulate the pressures of the phases according to the requirements of their individual loads without in any way disturbing the other two phases. By this means the single-phase loads, which are generally lighting, may have very close voltage regulation although the phases have different lengths and unequal loads.

With the four wire circuit trouble to one phase affects that phase only, and does not make the other phases become inoperative. Should one phase-wire fall to the ground or in some other way give trouble the circuit breaker controlling that phase will open, allowing the two remaining phases to continue operation. This is a very valuable feature of the four-wire circuit, as will be understood when it is thought that if trouble develops during the lighting load period but thirty-three per cent of the total load is interrupted. With the four-wire circuit little care need be taken to keep the loads balanced, although it is, of course,

better to have them so, because under all conditions the voltage regulation is practically independent of phase unbalance. whereas with the three-wire circuit each phase is influenced by the other two phases. The three-wire circuit requires that interconnected current transformers or interconnection of the coils of the contact making voltmeters be used, whereas with the four-wire circuit this is not necessary.

Since the voltage of the four-wire circuit is 4000 volts instead of 2300, less copper is required to transmit a given amount of power any given distance, and the use of the four conductors shows a very considerable saving in investment usually.

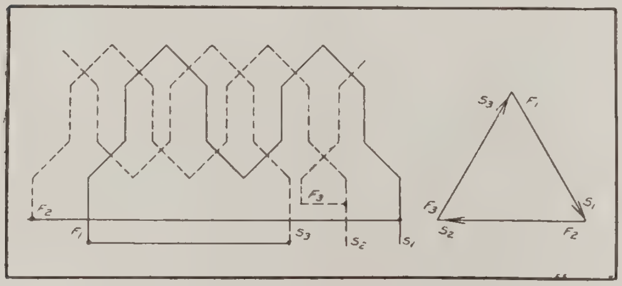
In summing up the advantages of the four-wire circuit it may be said they are flexibility, reliability, and economy, not to mention the other intangile advantages accruing from the above, which cannot very well be definitely expressed.

For serving power and lighting from the same circuit in cities and suburbs, where good voltage regulation is necessary, and the investment must be kept down to the lowest amount, the four-wire circuit is usually indicated. It is in use by some of the largest central station companies, and is fast coming more into use as its advantages are being better known. It enables results to be obtained that otherwise would not be possible, even at a much greater investment. K. R.

Three-Phase, 4-Wire Circuit, Ans. Ques. No. 528.

Editor Electrical Engineering:

The 3 wire 3 phase circuit may be used with either the D or Y connections, but the 4 wire 3 phase circuit is limited to the Y connections. Their names being derived from the vector diagrams. To obtain the 3 phase it is necessary to have three separate windings in a three phase alternator or transformer. It will be seen that the 3 winding will have 6 leads, 2 for each winding. It is usual to connect certain of the leads together inside of the machine so that only 3 leads have to be brought out and connected to the line.



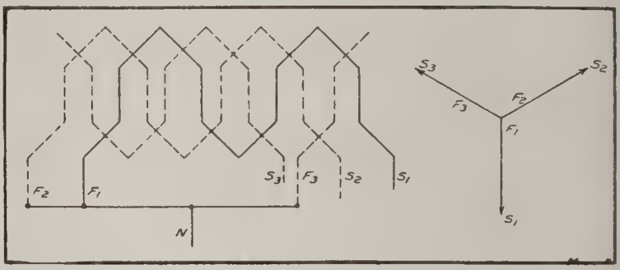
D Connection.

Figure 1 shows the D connection. The winding is connected according to the following table:

Start No. 1 to finish No. 2.
Start No. 2 to finish No. 3.
Start No. 3 to finish No. 1.

It will be seen that since the windings form a closed circuit, the e. m. f's. of the three phase would cause a circulating current to flow if it were not that the e. m. f's. are 120 degrees out of phase with each other, giving a resultant of zero.

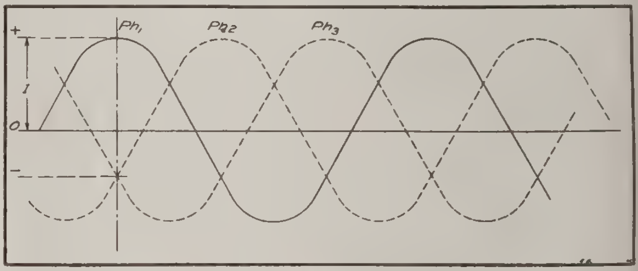
Figure 2 shows the Y connections. The finishes of the windings are connected together to form the resultant lead n. The current in this lead at any instant is the geometric sum of the currents in the 3 phases. The current in each of the 3 phase at any instant can be found from the curves in figure 3, from which it may be seen that at any instant the sum of the 3 currents is zero, so that the lead n may be dispensed with and the machines run with 3 leads, if the load is evenly balanced on all phase.



Y Connection.

It is easy to obtain a balanced load with 3 phase motors, but with a lighting load it is quite difficult. The 4th wire connected to the center of the Y is known as the neutral wire and performs the same function as the neutral of the ordinary 3 wire Edison system.

The voltage between any main wire and the neutral is 57% of voltage between any two main wires. For general distribution this system is desirable, requiring less copper



Curves of 3-Phase Current.

and giving greater flexibility than other systems. Three phase 200 volt motors may be supplied from the main wires, and 115 volt lamps connected between the neutral and each of the 3 phase main wires; if the lamp load be very nearly balanced the current flowing in the neutral will be very small as in the 3 wire direct current system.

A. H. .B

Three-Phase, 4-Wire Circuit, Ans. Ques. No. 528.

Editor Electrical Engineering:

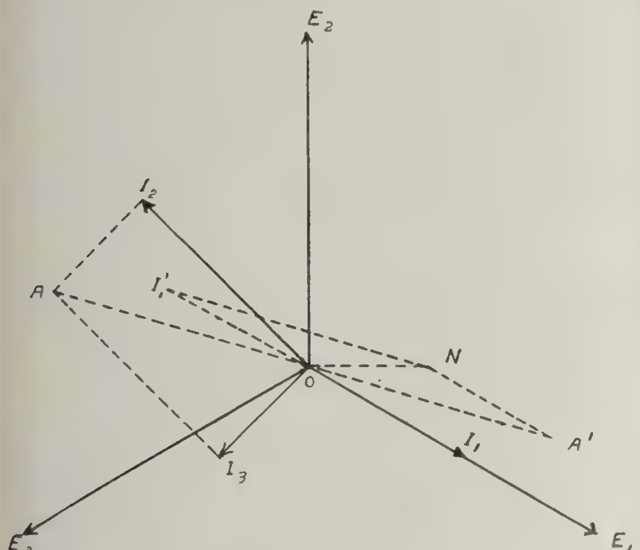
The fourth wire is essential in a system supplying unbalanced circuits, but is so much dead copper when the receiving circuits are exactly similar, since the total current in any one wire equals the vector sum of the currents in the other two and there is no current for the fourth wire.

Such devices as rotary converters, and induction motors have similar receiving circuits, and it is generally possible when supplying single phase loads to distribute each load to the three phases so as to make an approximately balanced condition. When this is not possible, the fourth wire is required because the unbalanced load on a three wire three phase system will cause the voltage across different phases to be unequal; a decrease in the power factor; an idle current of triple frequency to be set up in the arma-

ture; an idle current of double frequency to be set up in the field coils.

The idle current considered here is not the imaginary idle component of a line containing reactance, but a true current circulating in the armature and fields only.

, The need of a neutral or fourth wire is readily seen from the vector diagram where I_1, I_2 and I_3 are loads of unequal current and phase differences.



Vector Diagram.

O A is the vector sum of I_2 and I_3. To have a balanced system there should be opposed the current O A′. Instead, however, we have I_1 in the other phase, hence the vector difference O N must be taken care of by a fourth wire. By interchanging any two loads a different neutral current will be found so the unbalance can sometimes be reduced by switching a load to another phase. G. J. Crosby.

Reactance and Choke Coils, Ans. Ques. No. 529.

Editor Electrical Engineering:

There seems to be a lack of definite distinction in the use of the terms "choke coil," "reactance coil" and other apparently synonymous terms such as "kick coil," "reactive coil," "impedance coil" and "choking coil." Primarily devices coming under any of the above names serve to prevent a sudden change in the flow of an alternating current in a circuit or in some cases oppose its admission into a circuit to which it is foreign. During several years experience in telephony "reactance coils" were not met with but "choke coils" were familiar articles, consisting usually of a laminated core of iron wire wound with many turns of fine magnet wire, the whole measuring perhaps two inches in diameter by six inches long as a general rule. This type of coil inserted in a circuit served to prevent line surges, especially in direct current circuits; to keep ringing currents out of direct current relay circuits to some degree; to aid in causing stray power currents and lightning discharges to seek the earth instead of going through equipment which would be damaged thereby, and also had considerable theoretical application.

The term "reactance coil" seems to be rather new and to have originated in power work the device consisting as a rule of copper conductor, solid or stranded, sometimes insulated but usually bare, wound upon a massive porcelain, wood, or in some cases cement support, the turns numbering at the most probably not more than 250 or 300, being spaced from one-quarter to three inches apart and often only three or four layers in depth the completed coil measuring roughly two to three feet in diameter and anywhere from twenty inches to six feet in length and having an air core. This coil is placed in a bus or feeder circuit, the conductor being designed to carry the load of the circuit and the object of the coil to prevent short circuits or heavy grounds or sudden overloads from damaging the alternators serving the system. Also to prevent as far as possible the operation of auto-mechanical protective apparatus under such conditions, and in short to protect a transmission and distribution system from the effect of a disturbance occuring upon one of its branches. C. J. Purdy.

Reactance and Choke Coils, Ans. Ques. No. 529.

Editor Electrical Engineering:

A choke coil is a reactance coil, and vice versa. Both reactance coils and choke coils are coils possessing reactance, and it is their property of reactance that is utilized for the control, operation and protection of alternating and direct current circuits. While it is immaterial whether the coil be called a choke coil, a reactance coil, or a reactor, since the terms are synonymous, there is a generally understood difference between the coils, which is one of application not effect. For example, the coil used to protect an alternating current generator during the enormous current rush of the first few cycles of a short-circuit is always called a reactance coil, as is also the coil used in the alternating current side of a rotary converter for the control of power factor; the one invariably has no core while the other always is iron clad. On the other hand the coil used to protect apparatus from surges due to lightning, switching, etc., is usually referred to as a choke coil, while the inductive shunt used with direct current generators and rotary converters is known as a reactance coil; the one has an air core, the other a ferric. Then there are the non-ferric coils sometimes used to protect direct current railway machines from short-circuit when the feeders are of heavy copper and the feeder short; these are quite often called reactors.

It is seen that all these coils are utilized for the same purpose, namely on account of their reactance. While so many names for the same thing is unfortunate it is not of much importance really. Reactor or reactance is the term recommended by the A. I. E. E. and the N. E. L. A., the one in their Standardization Rules, the other in the Handbook of Overhead Line Construction. K. R.

Reactance and Choke Coils, Ans. Ques. No. 529.

Editor Electrical Engineering:

H. W. R. is entirely correct in that "reactance coils" and "choke coils" both depend on the principle of self-induction, or the production by the variation in current-value in any coiled circuit of an E. M. F. which opposes that very variation, or change in current which produces it.

The term "Choke Coil" is, according to the writer's best information, generally reserved for designating a particular kind of reactance coil which is to be used in connection with Lightning Arresters. "Choke Coils" are designed with the inductance L low enough so that the reactance 2pifl, for commercial frequencies, will be negligible; but for the high frequency disturbances, as lightning, this reactance 2pifL is quite enormous, and serves to hold back, or "choke" the

discharge, giving the Arrester more time to act. Hence the term.

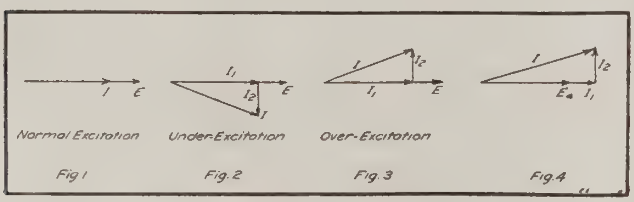
"Reactance Coil," it is thus seen, is a general name; and under it may come "Choke Coils," "Current Limiting Reactances," "Balance Coils" (for 3-wire generators), "External Reactances" (used in the A. C. supply of compound wound rotaries), and various other applications.

T. E. Tunison.

Synchronous Motors for Power Factor Correction, Ans. Ques. No. 530.

Editor Electrical Engineering:

It is quite possible to have a synchronous motor carrying a mechanical load and drawing a leading current from the line. This will be evident if the current is divided into two parts, one in phase with the voltage, the other 90° out of phase. These components are variously called power and wattless; active and reactive; in phase and out of phase components. The first or active component represents true power, such as mechanical load, friction, heating in the copper; the second or reactive component represents current used in magnetization which takes no true power.



Diagrams Showing Lead and Lag.

Fig. 1 shows the voltage and current in a motor operating at unity power factor. The whole current is in phase with the voltage so there is no reactive component of current. Fig. 2 shows a lagging current. Here I_1 is the same as in Fig. 1, but in addition there is a reactive component I_2. Since the energy component of the current, I_1, is the same in both cases the motor is driving the same mechanical load. The difference is that in Fig. 1 all the necessary field flux was supplied by the exciter through the field winding. In Fig 2 the field strength has been weakened so that in order to have a practically constant flux a magnetizing or reactive current must flow in the alternating circuit through the armature. This is a peculiarity of the synchronous motor that its magnetization can come from either the field or the armature, but the total flux must be nearly constant if the line of voltage is constant, since the counter e.m.f. of any motor must be nearly equal to the line voltage. This counter e.m.f. is produced by the conductors cutting the field as in a generator and is therefore proportional to the field times the speed of rotation. In a synchronous motor the speed is necessarily constant, so the field must be constant or else the counter e.m.f. would not be. (This is approximately true.) The current in the armature of any motor sets up magnetic flux which combines with the main flux. This is called "armature reaction." It has been found that in a synchronous motor the armature reaction due to lagging armature current strengthens the field, that due to leading current opposes it. If the field excitation should be increased by cutting out field resistance, the field flux would tend to increase but it has been shown that this must stay constant so the motor draws a leading current which has a reactive component just big enough to neutralize the increased excitation. Fig 3 shows a motor with the same mechanical load as Figs. 1 and 2, but over-excited, so that the reactive current I_2 is leading, giving the motor as a whole leading power factor. In Fig. 4 the mechanical load has been increased so I_1 is greater than in Fig. 3, but the field has not been changed, so I_2 is the same. This still gives a leading power factor but not so large a lead as before.

A summary of the above is this: Mechanical load does not imply lagging current. Mechanical load and true energy losses are supplied by current in phase with the voltage; magnetization is supplied by current 90° out of phase with the voltage.

R. H. Willard.

Synchronous Motors for Power Factor Correction, Ans. Ques. No. 530.

Editor Electrical Engineering:

The input to a synchronous motor, as with any other alternating current machine, may be considered as consisting of two parts, namely a watt and a wattless component. The one is the true or useful working portion, the other the magnetizing portion.

Speaking rather roughly, it may be said that the wattless current flowing in the synchronous motor is due wholly to the excitation of the machine, whereas the watt, or energy current is due to the mechanical load being carried by the machine, and to its own small losses. The input to a synchronous motor is a minimum at unity power factor, increasing as the power factor becomes lagging or leading, as the case may be. The reason for the increase in current at power factors other than unity is on account of the inequality of the impressed voltage of the circuit and the induced voltage of the motor, which causes the current to change either backward or forward with respect to the electromotive force of the motor. These "out of phase" or wattless currents are dependent upon the voltages of the circuit and the motor—that is upon the excitation of the motor—and are independent of the energy current flowing in the motor armature which depends upon the torque demanded by the amount of mechanical load. Of course the total current flowing is the vectorial sum of the watt and the wattless components. The excitation of the machine decides the one, the mechanical loading the other. At constant excitation a synchronous motor gives practically unity power factor at all leads.

K. R.

Synchronous Motors for Power Factor Correction, Ans. Ques. No. 530.

Editor Electrical Engineering:

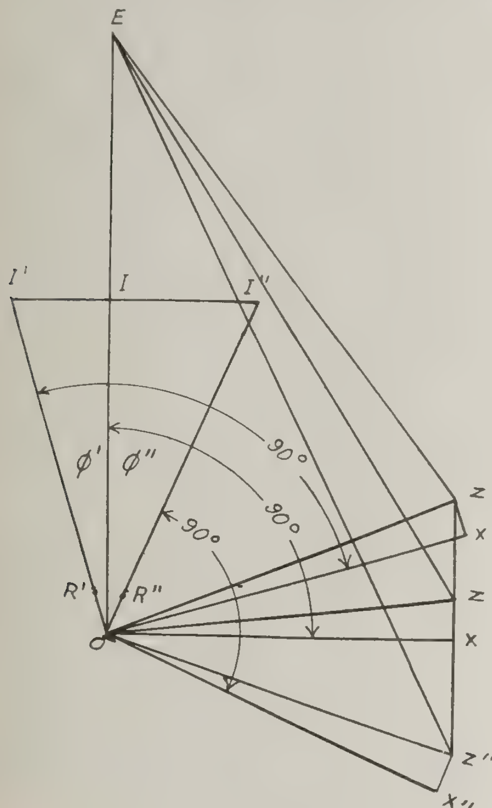
There are two methods by which the synchronous motor can be used to correct the power factor of an inductive circuit. The first is to have a constant load on the motor, then vary the field current; the second is to have a constant field current, then vary the load.

The first method is the one generally used. By this method the motor carries a constant load, and there is a definite field current, for this load, which causes the current to come into phase with the applied voltage, giving unity power factor. Now if the field current is increased, the over-excited motor will draw a leading current from the line. This leading current, of the synchronous motor, will now compensate for the lagging current of the line, and it is made of such a value as to give a power-factor of about .90. The motor can carry a load as before and in fact a

greater load is required to "break down" the motor. The only disadvantage is that the over-excited motor has a higher voltage than that of the line, causing the armature current to be large. Probably this method can be shown better by a vector diagram:

O E is the initial line and represents the line voltage.

O I represents the current taken by the inductive load.



Vector Diagram.

If a synchronous motor is now put into operation, at unity power factor, and its armature current added to the vectors O I, we have O I, with a power bettered by Cos. Θ—Cos. Θ_1. Now if the synchronous motor is over-excited it will draw a current leading the line voltage by 90 degrees, and this vector added to OI_1 gives OI_2, with a power factor of Cos. Θ_2. If the synchronous motor had not been used, but its equivalent load added, the line current would be represented by OI_3. D. G. McArm.

Synchronous Motors for Power Factor Correction, Ans. Ques. No. 530.

Editor Electrical Engineering:

It is well known that the synchronous motor, running without load on an alternating-current circuit, for instance, can have its armature current varied by varying its field strength. A certain adjustment of field strength will give a minimum armature current. Either stronger or weaker fields will give increased current. These increased currents are to a great extent wattless. If the field is weaker than the normal (i. e. the field for minimum armature current), the increased armature current is leading with respect to the e. m. f. waves in the motor and lagging with respect to the line e. m. f. The current in the motor therefore is corrective in its nature. For stronger than the normal field, the current is to a great extent lagging and tends to lessen the flux in the motor and the current is leading with respect to the line e. m. f. A synchronous motor therefore has an inherent tendency to correct conditions set up by improper adjustment of its field strength. The correcting current in the motor is drawn from the supply system and this current also has a correcting effect on the supply system, tending to produce equalization between generated pressure in the motor and the supply pressure. This characteristic of the synchronous motor can readily be utilized for two purposes; namely, for varying the amount of leading or lagging current in a system for producing changes in the power-factor of the system (including transmission line, transformers, and generators), or a synchronous motor can be utilized for pressure regulation in a system.

In the above, the synchronous motor has been considered only as a regulator and not as a motor. We will now consider what would be the effect if the synchronous motor can do useful work at the same time that it regulates the system. In this case, with a given rated output, one component of the input will be wattless, and the other part will be energy. The ratio cf these two components could be varied as desired. For example, considering the input as 100, the wattless component could be 60 when the energy component is 80; or the synchronous motor could carry a load of 80% of its rated capacity, this load including its own losses, and could have a regulating component of 60% of its rated capacity. If the motor is used as a regulating machine only, then its wattless component can be practically 100. It appars, therefore, that the machine could be used more economically as both motor and regulator than as regulator alone, but in such case it would probably be advisable to use a machine of somewhat lower speed than if operated entirely as a regulator. This reduction in speed may practically offset the gain in apparent capacity by using the machine for a double purpose. Also there is comparatively limited use for large synchronous motors for power purposes, as better results are usually obtained by subdividing the units and locating each unit nearest to its load. If a load could be provided which would permit very high-speed driving, then it would probably be of advantage to utilize the synchronous motor for driving.

A. H. B.

Synchronous Motors for Power Factor Correction, Ans. Ques. No. 530.

Editor Electrical Engineering:

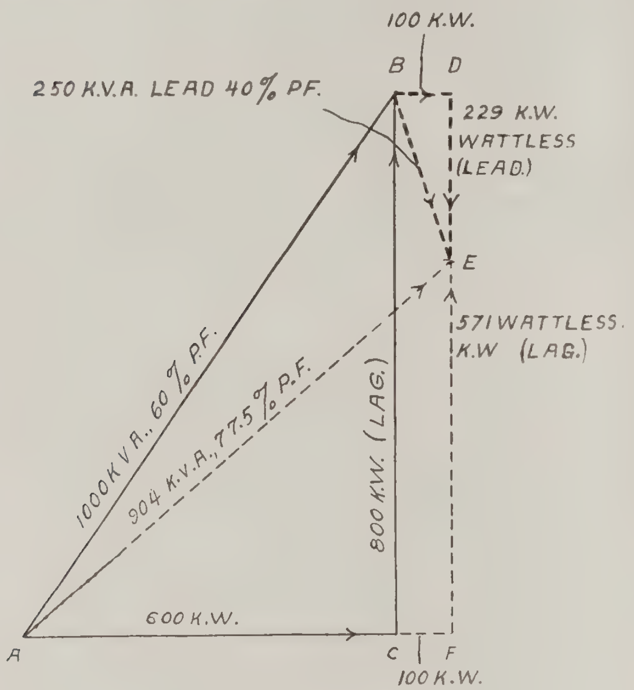
In a synchronous motor there are two E. M. F's. or Voltages to be considered; namely, the line voltage, and the Counter E. M. F. which is generated by the rotation of the armature conductors in the magnetic field. This latter will be referred to as the C. E. M. F. and the former as the line E. It is quite obvious that the C. E. M. F. is in opposition to the line E.

Now, if the field of the synchronous motor be over-excited, the C. E. M. F. will *tend* to rise above the line E in value. To prevent this there will flow in the armature windings of the motor a wattless current—or, more properly speaking, there will be a component of the armature current which is wattless, and this wattless component will be of such a nature as to neutralize the effect of the over-excitation of the direct current field magnets. This wattless component will *lag* with respect to the *C. E. M. F.* of the motor, and it will also *lead* with respect to the line *E*. Thus the synchronous motor will operate at a power factor less than unity, and *leading the line E*.

For an illustration of this action consider the figure herewith: The light, solid line triangle ABC represents a

load of 1000 K. V. A. at 60% P. F., carried, say, by a system of exactly 1000 K. V. A. capacity. This load is shown by the two legs of the triangle resolved into energy and wattless components of 600 and 800 K. W., respectively. It is thus seen that although our system is loaded to its full capacity as regards current and volts, yet the actual energy load carried is but .6 of the rated capacity.

By adding to this system a 250 K. V. A. synchronous motor condenser operating at 40% P. F. (shown in the figure by the heavy dotted triangle BDE), it will supply mechanical load and actually draw from the system 100 K. W. of energy load. Simultaneously, it will draw from the line a wattless leading component of 229 K. W. Since this wattless leading component added by the synchronous



Lag and Lead Diagram.

motor is directly opposed to the wattless lagging component of the system, the two may be combined algebraically, leaving a net lagging component of (800-229) or 571 K. W. The actual resultant energy load will be (600 plus 100) or 700 K. W. And the resultant K. V. A. will be $\sqrt{(700)^2+(571)^2}$ or 904 K. V. A. The new power factor will be—

$$\frac{700 \text{ K. W.}}{904 \text{ K. V. A.}} \text{ or .775, which is 77.5\%.}$$

And now, with the 1000 K. V. A. system carrying only 904 K. V. A. there is a reserve capacity of (1000-904) or 96 K. V. A. At the new P. F. this will be 96 K. V. A. times .775, or 74.45 K. W. T. E. Tunison.

Grounding Transformer Cases, Ans. Ques. No. 531.

Editor Electrical Engineering:

The grounding of transformer cases has been advocated solely as a precautionary measure against lightning. Connecting the lightning arrester to the transformer case, and grounding this latter is a most effective, and very inexpensive, method of protecting the windings of a transformer. The reason that it is not being done to a greater extent than it is, is on account of the life hazards that result. The close proximity of a grounded transformer case to where a lineman is working on a pole seriously increases the chance of accident.

The object of protective devices is to prevent an excessively high potential existing between transformer primary and case and secondary winding rather than between primary and ground. By connecting the lightning arrester to the transformer case the transformer windings are protected to a much greater extent, although the potential to ground may be far in excess of normal. The grounded transformer case, and by that is also understood the connection of the lightning arrester to the transformer case, eliminates the deleterious influence of a high resistance ground connection, and the inductance of the ground wire, still further assisting the protection.

Where lightning is severe it is advisable to ground the transformer case, and connect a lightning arrester on the same pole as the transformer. Linemen should be impressed with the importance of keeping clear of the transformer case under these conditions, especially when hiring new men. K. R.

Static Discharge from Belts, Ans. Ques. No. 533.

Editor Electrical Engineering:

In case of a machine with the frame insulated from the ground, the induced charge in the winding might puncture the insulation, but this is not likely if the frame is grounded. In either case I should put on a static collector. Safety first applies to machinery as well as human beings. The static would have no appreciable effect on belt friction.

B. C. Rathbun.

Grounding Transformer Coils, Ans. Ques. No. 531.

Editor Electrical Engineering:

In any transformer there is a possibility that the high-tension winding may become metallically connected to the core or case through the failure of the insulation, so that if the case is not connected to the ground it may be raised to a high potential above the earth. Under these conditions a person coming in contact with the case may receive a dangerous shock. It is to prevent this condition that the case is grounded, and not as a protection against lightning, for it affords none. A. H. B.

Grounding Transformer Cases, Ans. Ques. No. 531.

Editor Electrical Engineering:

Grounding the cases of transformers and oil switches does away with the static charge otherwise apt to be present which is capable of giving a very disagreeable and in case of high tension apparatus sometimes a dangerous shock, and which might increase the fire risk in discharging to floors, etc.

I do not know of any reason why it should protect the transformr from lightning as if a charge should reach the transformer and puncture the insulation the transformer would go up whether grounded or not.

B. C. Rathbun.

Static Discharge from Belts, Ans. Ques. No. 533.

Editor Electrical Engineering:

The writer's experience with static discharges from belts has been such as to indicate that under the right conditions there is danger of weakening the insulation of the windings.

The following is an instance of what static discharges from a belt have done:

A 500 K. W. 2300 volt 3 phase National Gen. running at 360 R. P. M. was driven by a Corliss running at 90 R. P. M. Engine belt wheel 18 ft. diameter. Generator pulley 4½ ft. diameter. Belt 48 inches wide and three ply leather. Generator insulated from ground by 12"x12" timbers.

The generator ran for almost a year without trouble, then gradually static discharges began to pass from the field into the armature coils. These discharges became so heavy (they sounded like the blow of a sledge hammer), that they caused short circuits in a number of coils which had to be cut out of circuit until new ones could be obtained to replace them. Efforts were made to get rid of the static by grounding the generator frame. This seemed to only add to the trouble, for coils which now became slightly grounded on the armature laminations quickly burnt out. After much experimenting two methods were used which worked very well. One was placing small blocks of dry wood about 1/32" to 1/16" from the generator frame. On these blocks lead pencil lines were drawn radiating from a point where a ground wire was attached. The static following the path of least resistance jumped to the graphite lines and thus to the ground. The other method used was bending a No. 0000 copper wire into a "L" shape and inverting the "L" under the top side of the belt at a distance of about 3 inches. This wire was also grounded and eliminated much of the static.

Static discharges were greater in damp weather and the belt, which was also affected by the dampness, stretched until it slipped. This slippage does not seem to be increased or diminished by eliminating part of the static from the belt by the wire bent in "L" shape.

F. McGough, Jr.

Testing Efficiency of Synchronous Motor, Ans. Ques. No. 537.

Editor Electrical Engineering:

The efficiency of the generator can be determined by dividing the electrical output, by the electrical output plus the losses. The losses in the machine are made up of the copper loss in the armature and the field circuit, the iron loss in the armature core, and the mechanical losses such as bearing friction, brush friction, and windage. The copper loss can be determined from measuring the ohmic resistance of the armature fields and multiplying this by the square of the current. The iron loss and friction loss is generally lumped together, and is determined by measuring the amount of power required to drive the armature of the machine at full speed, and full field excitation without any load. This power is absorbed by the iron loss and the friction.

It would probably be most convenient for you to determine the efficiency of the small belted generators by driving them connected to a small motor by a chain, such as a Morse type. An ammeter and a voltmeter arranged so that you can throw it into the motor circuit and into the generator circuit will give you the necessary data for calculating the output of the generators at the required speed and load called for by the excitation of the alternator. By reading the amperes and volts in the motor circuit when it is operating the generator at no load, you will thus have a measure of the iron loss and friction for both the motor and generator. By disconnecting the driving motor from the generator and reading the power taken by the motor when running idle, you will have the windage and friction and iron loss for the motor itself. By subtracting this from the total for the motor and generator, you will have the iron and windage loss for the generator. By measuring the resistance by the fall of potential methods in the filed and armature of the generator, and connecting in an ammeter to find out the field current at full load, you will be able to calculate the (I Squared R) or copper losses in the field and armature. By reading the ammeter and volt meter when the generator is operating at full load and exciting the generator, you have the output, and this divided by the outptu plus losses will give you the efficiency of the unit.

This same scheme can be used for finding the efficiency of your synchronous motor-driven set, except that you will require a watt-meter, as well as an ammeter and a voltmeter in your synchronous motor circuit in order to determine the power taken by the motor in driving the generator.

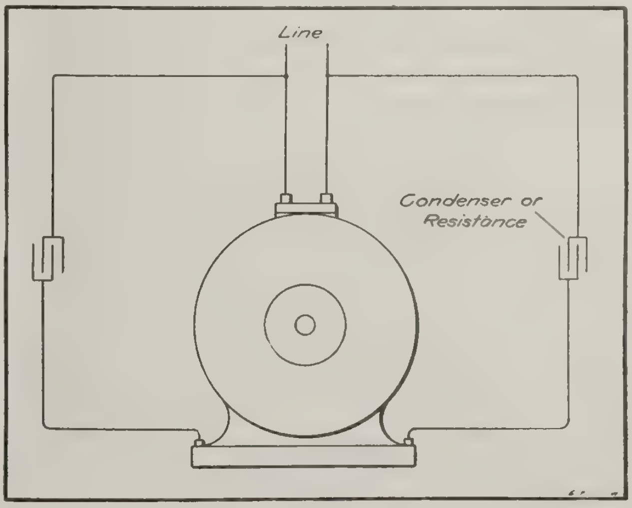
You will find it advisable to take into consideration the belt slippage when determining the efficiency of the generator connected to the A. C. generator shaft. You can do this by operating the generator driven by the small motor so as to give the required field current for the alternator, and then note the speed by means of a counter. Check this speed against the speed of the generator when driven by the belt from the alternator shaft, and generating the same filed current in the case when field is measured with the exciter driven by the full motor. The efficiency of the chain can be taken at about 99%. That is, 1% of the power of the driving motor to the generator is absorbed by the chain. Inasmuch as the synchronous motor will be direct connected, it may be well to take into consideration this loss between motor and generators taken up in the chain, and considering the losses for the small generators.

D. H. B.

Static Discharge from Belts, Ans. Ques. No. 533.

Editor Electrical Engineering:

If the motor frame is not grounded and line is, as usual, there will be a tendency for the static charge to leave the belt at the pully and try to make a path through the insulation to the line and then to the ground. If there is no objection to grounding the frame the danger will be removed by doing so. While, if it is desirable to keep the motor frame clear of the ground, as the circuit is grounded, it will be advisable to connect the frame of the motor to both sides of the line through condensers or high resistances as shown in the sketch. A. H. B.



ELECTRICAL ENGINEERING

(Formerly Southern Electrician.)

JOSEPH J. COSGROVE, Managing Editor.

Devoted to the generation, transmission and distribution of electrical energy for lighting, heating, power and traction. Correspondence suitable for the pages of ELECTRICAL ENGINEERING is solicited and paid for. Name and address of correspondents must be given,—not necessarily for publication.

Published monthly by the W. R. C. SMITH PUBLISHING CO., at Dalton, Ga.; editorial and advertising departments, Grant Building, Atlanta, Ga. Entered as second-class matter at the postoffice at Dalton, Ga. Subscription rate $1.00 for two years; Canada $1.00 a year; foreign $1.50 a year.

Vol. 47. AUGUST, 1915. No. 8

CONTENTS.

The leader is the man who does the thing that the other fellow was just going to do.

Two things never overtaken are the wasted moment and the spoken word.

Cheerful men may not always be prosperous, but they've got a heap better chance than the grouch.

Even the man whose life is an open book occasionally likes to paste a couple of pages together.

The art of talking is great; the art of listening is greater; the art of saying something is greatest.

Always be on time keeping at appointment. It gives you a chance to rest up while waiting for the other fellow.

American Electric Railway Association Advocates Better Relations Between Carriers and Public.

More than 5000 members and delegates, including many electric traffic experts and engineers of nation-wide prominence, will attend annual convention of the American Electric Railway Association, to be held at the Exposition Civic Auditorium, October 4-8 inclusive, at the invitation of the Panama-Parific International Exposition. A feature of the proceedings will be the outlining of plans for the promotion of better relations between the electric carriers and the public. The American Electric Railway Manufacturers Association, an allied organization, will hold its convention in conjunction with the frst named association, which consists of the parent organization and four affiliated organiations composed of accountants, engineers and transportation and traffic experts.

The association is already making elaborate preparations for the convention, which is the first to be held as far west as San Francisco. Three special trains from New York and one from Chicago have been arranged and it is probable that there will be additions to this number, as the usual attendance is more than 5,000. The association represents 36,000 to the 41,000 miles of electric railways in the United States and its members receive more than $500,000,000 of the $533,000,000 yearly receipts from the electric lines. Their employes number 270,000 of the 300,000 engaged in electric railway service. During the last year these companies carried more than 12,000,000,000 passengers, which is more than seven times the population of the world.

Electric Railway Profits.

In many cases much of the pressure that has been brought to bear upon regulatory bodies to reduce fares and at the same time extend service has been the result of a popular misconception concerning profits in the electric railway business. Mr. F. W. Doolittle, Director of the Bureau of Fare Research of the American Electric Railway Association has expressed himself as follows on railway profits:

"The operation of public utilities is a business and a business more conspicuous in difficulties than in profits. The regulation of public utilities must also be treated as a business proposition and is itself one of many preplexities. The urban electric railway business in particular is not one of exorbitant profits, as the results of many recent investigations indicate. An annual revenue of more than 20 per

cent of the investment is rare, and of each dollar of revenue probably 75 cents must go for operating expenses, taxes, and rentals before the investment charges of interest, dividends and depreciation can be met.

"Nor is this small and extremely narrow margin due altogether to the inclusion of totals of transportation companies serving districts of low traffic density. Recent figures show that in the last fifteen years the standard of service and equipment on many of the larger urban properties have so increased that the relation of annual revenue to investment has changed materially, falling from say 30 per cent to 20 per cent. This change has been in a few cases accompanied by a slightly falling percentage of operating revenue. That this decrease in operating ratio has not offset the greatly increased demands of the community for service at an unvarying fare is shown by the fact that where formerly the difference between operating revenues and operating expenses was 10 per cent of the capital invested, it has lately decreased to 6 per cent.

"While regulation of public utilities has been rather generally accepted as wise and a forward step in the economic life of the community, Mr. Doolittle said, it is still in the process of development, both as to the law on which it rests, and as to methods of administration. Material progress along both lines has waited on the fuller realization of the fact that the public utility exists because certain financially courageous individuals, whose money is now invested in good faith in public service enterprises' risked their capital, and that additional capital is not now forthcoming for extensions and improvements, and will not in the future be available for such purposes, unless the operation of public utilities is placed on a sound business basis."

Inter-Relationship of Combination Companies.

In line with that part of the discussion in this section of the January issue on the relationship of the various departments of combination corporations, we quote a financial writer in a recent issue of the *New York Commercial* on the inter-relationship of traction, heat, light and power companies.

"The great benefits that have been and are being derived from the operation under one management of light, heat, power and traction properties in a municipality are obvious. The results have been most remarkable and not altogether fully appreciated by the public. It has resulted not alone in tremendous economies in operation, but has enabled such companies to render far more efficient service and at lower rates in many cases than was possible before the combinations were effected. As an illustration; it is considerably more expensive to operate independently a public steam-heating plant in a community than to operate it in conjunction with an electric lighting and power plant, for the reason that in the latter case it is possible to utilize to a considerable extent the exhaust steam, thus effecting large economies in coal consumption.

"No argument is necessary to show that the larger the operation the greater the possibilities for economy and efficiency. This applies particularly to the combined operation of electric light, heat, power and traction companies in a single community. The combination or consolidation of such utilities, or any two of them, in many localities throughout the country, has served another important purpose; it has brought into many of the larger corporations the best available engineering skill, which has resulted in substantial construction, permanency, and stability as well as efficient and capable management. And more important than anything else, these larger combinations of utilities, the proper construction of the plants and the selection of suitable equipment through competing engineers, have brought to the rescue the necessary backing of large financial interests.

"It is well known that the business of traction, light heat and power companies increases from year to year, even in greater proportion than the growth in population, which necessitates the securing of new capital with which to construct the necessary additions and improvements. This is a most important factor in the development of such properties. In many of the smaller communities where properties were formerly operated independently by local interests, and in many cases by incompetent management, it has been impossible to secure the necessary capital to meet the growing demand of the service.

"The phenomenal growth of the electric light and power business alone, which it may be said has been greater than any other industry, is shown in the reports of the Bureau of Census for a period of five years up to 1907, according to which, the cost of construction and equipment in 1902 amounted to $482,700,000 and in 1907 to $1,054,000,000—an increase of about 118 per cent. The gross income of electric lighting companies increased within that period from $78,700,000 to $161,600,000, an increase of 106 per cent, while the net income showed an increase of over 130 per cent.

"The business of these companies is certainly now well established on a sound and substantial basis, and through the efforts of important banking interests, which are instrumental in effecting corporations of different properties with a view to effecting greater economies, efficiency, and proper construction, is becoming more and more so every day. Unquestionably there are still wonderful possibilities for the future in the development of these enterprises on a large scale. From the standpoint of the investor in public utility securities it is evident that with the introduction of new and up-to-date methods and equipment, and with capable management, his interests are the better safeguarded.

"Unquestionably the growing demand for the securities of public utility companies is largely due to a better appreciation of the substantial character of such properties and their ability to show increasing earnings even in periods of business depression. By way of comparison; the gross earnings of seven industrial corporations in 1907 (the year of the panic) were $888,977,000 against $597,115,000 in 1908—a decrease of about $291,000,000. Seven representative railroads showed gross earnings of $581,809,048 in 1907 and $540,464,821 in 1908—a decrease of about $41,000,000. The same number of electric light and gas companies, fairly representative of their class, showed gross earnings of $30,627,399 in 1907 and $34,015,847 in 1908—an increase of about $3,400,000. This is certainly an interesting comparison and places electric light and gas companies in a very favorable light.

The great importance of stability of earnings from the viewpoint of the investor cannot be overestimated. From the above facts, therefore, it would appear that the investor in the securities of well managed public utility companies is not only equally secured, but he can secure a better return upon his money than through an investment in railroad securities."

Concerning the Electrical Trade

News of Activity by Jobbers, Dealers, Contractors, Central Stations and Manufacturers.

Mr. Thos. Burke, Southern Sales Manager Western Electric Company.

It is superfluous to introduce him, particularly to the electrical interests of the South, when for ten years he has been high priest and missionary preaching the gospel of electricity—then more electricity. Like all successful men, he started at the foot of the mound and toiled steadily and progressed upward. It was on July 19th, 1904, that he first entered the electrical business as bookkeeper for the Carter & Gillispie Company, and so valuable were his services to them that within one year he was made secretary and treasurer of the company.

In 1906 the Carter & Gillispie Electric Co. divided their business, continuing the contracting business as the Carter and Gillispie Electric Company and organizing a jobbing house known as the Southern States Electric Company. Mr. Burke was elected secretary and treasurer of this jobbing company also.

Mr. Thomas Burke.

But you cannot hide an electric light under a bushel. Its rays will shine through some of the joints and proclaim itself to the world. So it was with Mr. Burke. In 1907 he was tendered and accepted a position with the Western Electric Company as Southern Sales Manager, the territory at that time consisting of Georgia, Alabama, excepting Mobile, and the northern part of Florida to the Alabama line, with the exception of Jacksonville.

In 1908 the Western Electric Co. opened up a warehouse at 212 Bay street, Savannah, all of Florida and a portion of South Carolina having been added to his territory.

Not to neglect his home city, in 1912 they opened up a city store at 31 Luckie street, Atlanta, Georgia; and the next year Mississippi and Louisiana were added to his territory so he opened an office and warehouse in New Orleans.

Mr. Burke believes "in time of peace prepare for war," so taking advantage of the recent slack times he has opened a new warehouse and office in Birmingham, Ala., to be ready for the flood of business due in September. He now has under his direction all of the states of Georgia, Florida, Alabama, South Carolina, Mississippi and Louisiana.

The following are among the many goods manufactured and carried by the Western Electric in their extensive line:

The Western Electric Company manufacturers: Telephone switchboards, apparatus and accessories; lead covered cables, power apparatus, fan motors, Western Electric Sturtevant vacuum cleaners, Western Electric washing machines, Western Electric Pittsfield spark plugs, Western Electric Blue Bell batteries.

The Western Electric Co. handles:

Conduits and Fittings—American Conduit Mfg. Co., Pittsburgh, Pa.; American Circular Loom Co., Boston, Mass.; National Molding Co., Pittsburgh, Pa.; Safety-Armorite Conduit Co., Pittsburgh, Pa.

Sockets and Receptacles—Bryant Electric Company, Bridgeport, Conn.; Harvey Hubbell, Inc., Bridgeport, Conn.; Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

Fuses and Cutouts—D. & W. Fuse Co., Providence, R. I.

Weatherproof and Rubber Covered Wires—Phillips Insulated Wire Co., Pawtucket, R. I.; Habirshaw Wire Co., Yonkers, N. Y.

Reflectors and Specialties—Benjamin Electric Mfg. Co., Chicago, Ill.; Holophane Works, Cleveland, Ohio.

Fixtures and Globes—Luminous Unit Company, St. Louis, Mo.; Beardslee Chandelier Mfg. Co., Chicago, Ill.

Street Lighting Fixtures and White Way Posts—Geo. Cutter Company, South Bend, Ind.

Construction Material—Fletcher Mfg. Co., Dayton, O.

Pole Line Hardware and Construction Material—Hubbard & Company, Pittsburgh, Pa.; American Cross Arms Co., Chicago, Ill.

Heating Apparatus—American Electrical Heater Co., Detroit, Mich.

Flashlight Material—American Ever-Ready Co., Long Island City, N. Y.

Dry Batteries—National Carbon Co., Cleveland, Ohio.

Iron and Steel Wire and Stranded Cable—John A. Roebling's Sons Co., Trenton, N. J.; Indiana Steel and Wire Co., Muncie, Ind.

Panel Boards and Knife Switches—Frank Adams Electric Co., St. Louis, Mo.; Crouse-Hinds Co., Syracuse, N. Y.

Specialties—W. N. Matthews & Bro., St. Louis, Mo.

Residence Lighting

By J. R. Roberts.

Light and shadow are the two opposites which are of the most importance in a consideration of the lighting of buildings. The beautiful play of varied tones of light in some cases throws into mild relief the objects to be seen, which are outlined by the shadows; while in other cases the object itself is flooded with light, standing in bold relief out of a darkened background.

There are many considerations that enter into the satisfactory illumination of a building, all of which affect the design of the lighting fixtures. First of all, light is utilitarian. It is needed to light our way, prolong light hours, and permit the performance of work which could not be done in the darkness. Again, the light might be used for artistic purposes to bring out the rich ornamentation of a room, whether the ornamentation be in the nature of sculpture, bas relief, carving or painting. The fixtures, too, must harmonize with their surroundings, and it is an art itself to either design or select fixtures suitable for the size, shape, furniture and finishing of various rooms.

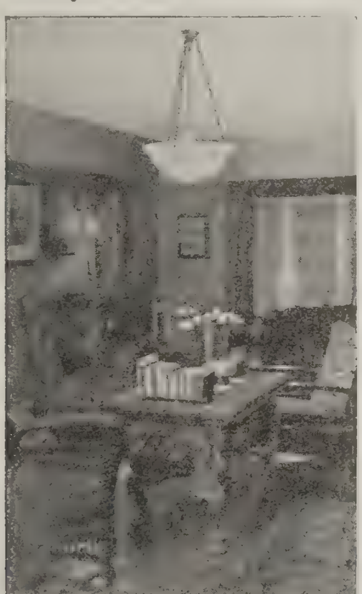


Fig. 1. Room Lighted by Reflected Light from a Macbeth-Evans Glass Co. Fixture.

Fig. 4. Indirect Lighting Fixture with Cut-Away Bowl to Show How Reflectors Direct the Light. Made by National X-Ray Co., Chicago.

The illumination of a room or building can be whatever we wish it to be, if we take into consideration the effects we want to produce, and the effect on the light of walls, ceilings and objects in the

Fig. 2. Room Lighted by a Diffusing Globe made by Macbeth-Evans Glass Co.

Fig. 3. Ornamental Lamp, Macbeth-Evans Glass Co., Pittsburgh, Pa.

Fig. 5. Oak and Mahogany Lamp made by the Daisy Woodcraft Company.

Fig. 6. Smokers' Cabinet and Reading Lamp made by the Daisy Woodcraft Company, Firibault, Minn.

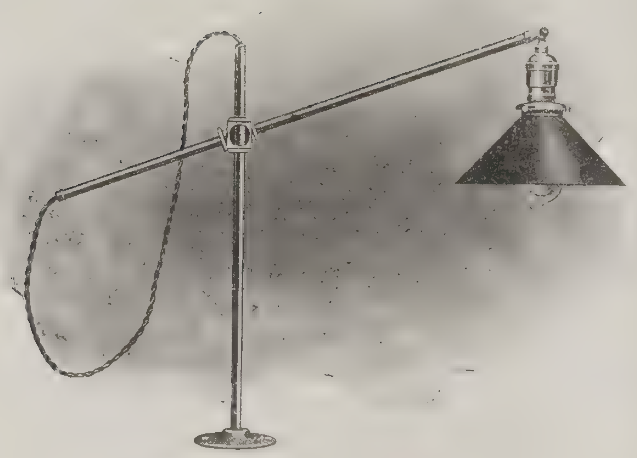


Fig. 7. Adjustable Bench or Work-Room Fixture made by Peter Forg, Somerville, Mass.

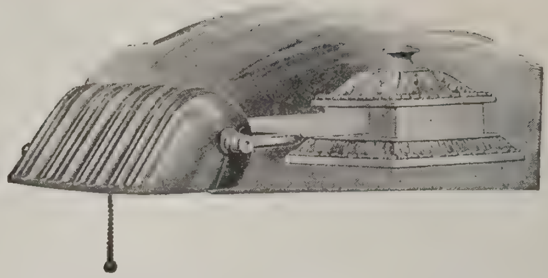


Fig. 9. Desk-Light Reflector made by the Goshen Novelty & Brush Co., Goshen, Ind.

room. Nothing is too trivial to be overlooked. The color of light, for instance, is often much altered on its way from the light source to the point of utilization. In direct illumination, all light is more or less altered in color, the degree and quality depending upon the color of ceiling and walls. Experiments have shown that a ceiling which is only slightly yellow will so alter the light from a tungsten lamp that the useful rays become as yellow as those from a carbon incandescent lamp. This affect of wall and ceiling color on the quality of light ought, therefor to be taken into consideration when planning the illumination of building interiors. Of course it is impossible in small buildings of the operation kind to learn beforehand what the color of the walls and ceilings will be, or the kind of furniture which will be used, but in large semi-public buildings like clubs and hotels, as well as in the more expensive homes, this information will usually be available.

As a rule, a white light similar to daylight is the ideal aimed at in the lighting of rooms. Sometimes however, colored light is desired, and this can be had by a happy combination of colored lamps and of wall and ceiling tints. The yellow light of a carbon incandescent lamp can be readily obtained for instance by applying a yellow dye to tungsten lamp bulbs. The advantage of coloring tungsten lamps instead of using the carbon lamps lies in the fact that with dyed tungsten lamps there is only a small loss in efficiency, so that both brilliancy and color are obtained.

Direction of light is an important consideration in music room; ball room; library and dining room,

Fig. 8. Cut-Crystal Chandelier, made by Siegman & Weil, New York City.

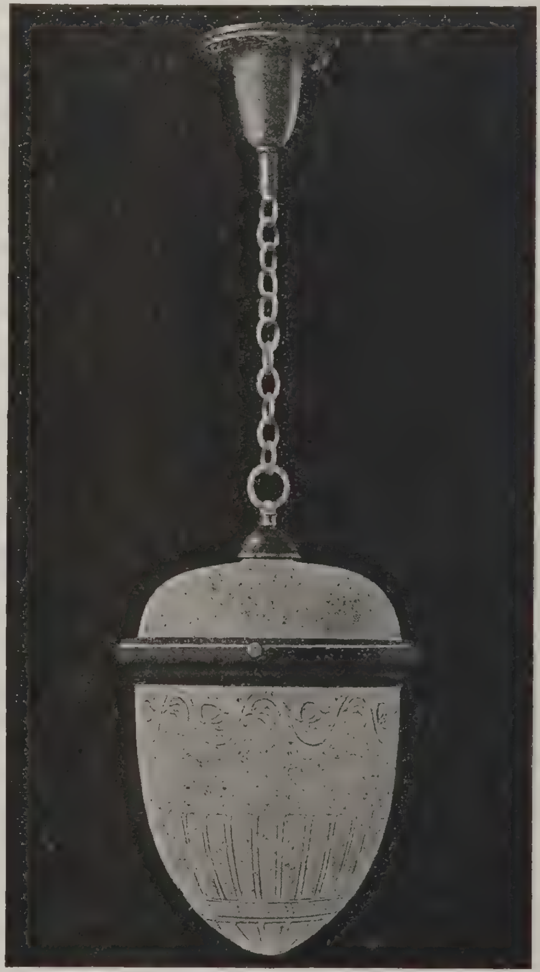


Fig. 10. Fixture for Nitrogen Lamp, made by Pittsburgh Lamp, Brass & Glass Co., Pittsburgh, Pa.

Figs. 11, 12, 13. Asbestos Shades and Reflectors, made by the Asbestos-Gleam Mfg. Co., Chicago, Ill.

or in any place where effect is desired. It has been said that light models sculpture and architecture but merely illuminates paintings. Admitting that to be true, the direction of light will have a lot to do with the beauty of an interior. It is well known that in photography the artist gets his results by a play of light and shadow over the features of the sitter. For ordinary expressions soft, light, shadows are desired, while for tragic or severe expressions dense, sharp, shadows are required. These shadow effects the artist secures by flooding his studio with

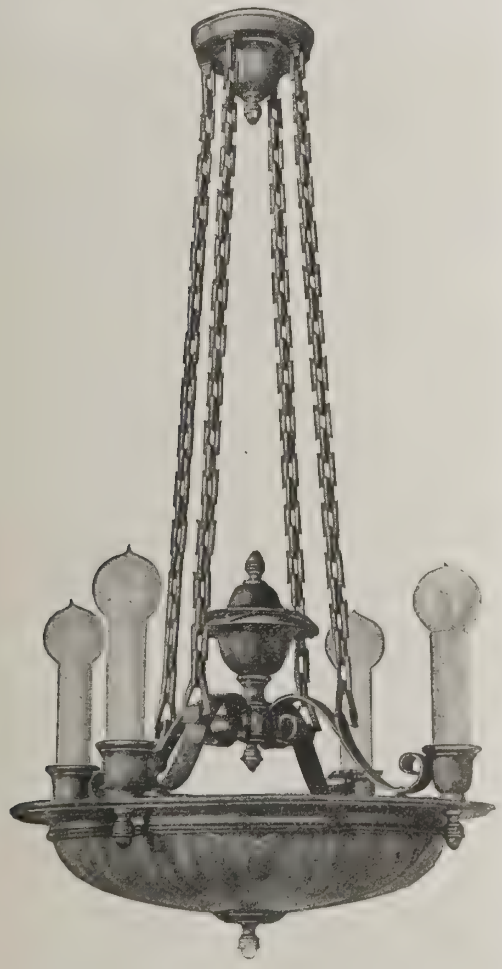


Fig. 14. Ceiling Fixture, made by R. Williamson & Co., Chicgoa, Ill.

Fig. 15. Electric Lamp, made by Shapiro & Aronson, Brooklyn, N. Y.

diffused light from one direction, then reflects light where he wants it to overcome shadows, by the use of screens and reflectors.

If light were to play on the person to be photographed from all sides, the portrait would be a failure, for the lack of shadows would give a distorted and unnatural expression to the features. So it is in the home. Light from one direction will throw into relief works of sculpture and of art. The moldings on doors, windows, and other trim will show lights or shadows according to whether it is a raised member or a depressed groove or hollow that is viewed. Relief work, statuary, vases and other objects likewise will appear at their best for with the light flooding them from one side only, the outline will be traced on that side by a line of light while a similar line of shadow will be traced on the opposite side.

While it is pretty generally known to those who are interested in lighting that lights and shadows play an important part in securing the effects desired, unfortunately there are no exact rules as to quality and quantity of shadow which can be given the reader. Good taste in such matters and judgment ripened by experience and observation must suffice until such time as rules are formulated.

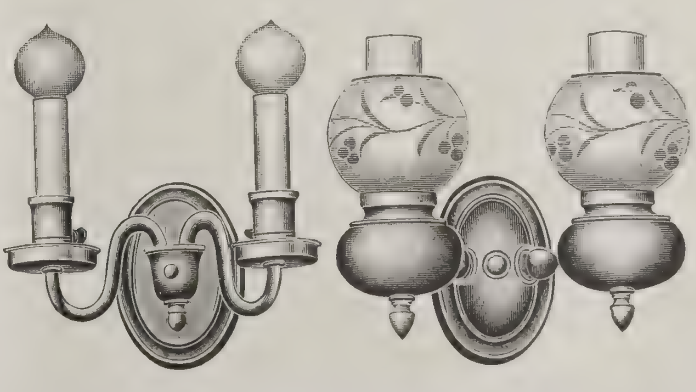


Fig. 16, 17. Wall Brackets in Old Brass Finish, made by Edward Miller & Co., Meriden, Conn.

brightness of the light source, and by absorbing and radiating the original light from a larger surface, softens the effect and takes away the glare without detracting materially from the quantity of light. Not only the translucent, transparent and reflective qualities of the globes and shades have been vastly improved, but the design of globes and shades or reflectors has received a good share of attention so that by their use light can be directed in almost any direction, can be confined to any desired area, and can be of any required shape.

Much information on the subject of lighting can be had by a careful reading of manufacturers' catalogues, and those making a specialty of lighting will find it to their advantage to have a complete file of lighting-fixture catalogues in their cabinets.

For the proper distribution of light there must be fixtures; and from what has already been said it would follow that lighting fixtures are more than mere arms, standards and pendants with cross arms and branches for holding the lamps. There are many requirements which fixtures must conform to if they are to prove suitable for their purpose. As has been pointed out already, the fixtures must be built upon the right principle and provided with suitable glass ware so as to flood the room with the right quantity and quality of light, and coming from the proper direction.

Further, they must be suitable for their surroundings, and located where they will not cause glare. This matter of pleasing design and harmony is of more importance than would appear at first thought. If the fixture is not pleasing to the eye, it is out of place in any artistic surrounding, and all homes aim, more or less, to be beautiful. Again, a fixture might be beautiful when viewed by itself, but utterly out of harmony with its surroundings. A lighting fixture, for instance, which would be quite suitable for a room finished and furnished in the style of Louis XVI, would be wholly out of keeping in a Moorish den or room of Turkish settings. Craftsman buildings, trim and furniture, likewise, would require different treatment of the lighting fixtures than would a cottage of English design; and a smoking room ought to have types of fixtures different from the dining room, living room or chambers.

A word as to the location of lighting fixtures in the work rooms of a home, such as laundry, kitchen and sewing room, might not be out of place in an article on the lighting of buildings. In many such rooms the lack of forethought on the part of those having the matter in charge is too often evident in the discomfort and annoyance caused. No electrician can err in this matter if he will study the location of the various fixtures such as sinks, laundry tubs and range, and so locate the electric lights that there will be a flood of light at all work points and coming from such directions that there will be neither an objectionable glare in the eyes of the workers, or a shadow cast by their bodies where light is most needed to see what is being done.

Fig. 28. Colonial Brackett, made by the Scott-Ullman Co., Cleveland, Ohio.

New Apparatus and Appliances

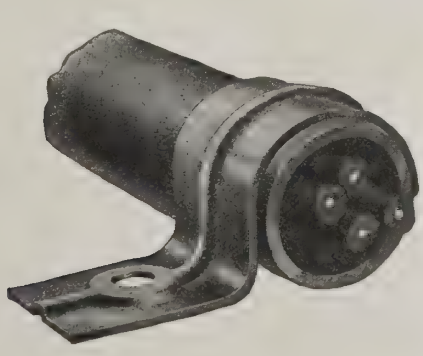
"Arrobell" Porcelain Socket.

The "Arrobell" Porcelain Socket, manufactured by the Arrow Electric Company, Hartford, Conn., is designed for bathroom work and damp places where the Underwriters' require a porcelain socket.

With this socket a husk and round glass globe is unnecessary, as the socket is designed to be used with a G No. 25 round bulb standard Mazda lamp. The lines of the socket harmonize well with this lamp and the round porcelain skirt of the socket gives the effect of a white enamel husk. The porcelain is pure white, nicely glazed and attractive in appearance This socket is interchangeable with any of the caps and bases listed under Interchangeable Porcelain Sockets. These are regular 1/8 inch, 1/4 inch, 3/8 inch and 1/2 inch caps, National Metal Molding—Cleat, Concealed, 3 1/4 and 4 inch Outlet Box Bases.

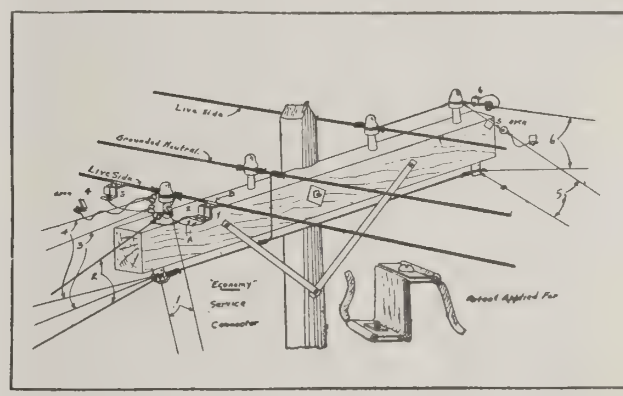
The Jiffy Clip.

The Minerallac Electric Company, Chicago, Ill., has just added to their line a substantial clamp for hanging pipe, conduit and lead covered cables. With this clip only one screw or bolt is required to hold the pipe, conduit or cable and clip firmly in place. The Jiffy Clip is made to afford great strength without being heavy or bulky, by having a rib drawn in the center of the clip. A round boss is also raised on the clip, through which is a hole for the screw or bolt. This boss serves the purpose of a lock washer to prevent the clip from working loose.



The Economy Service Connector.

The Economy Service Connector Co., 609 West Fifth Street, Coffeyville, Kansas, is putting out a simple, inexpensive and convenient device for disconnecting and reconnecting service lines to transmission wires. The clamps of all connectors are interchangeable so that the small size can be used in connection with the large size. This makes it possible to install one large size on the main line wire, and permit two of the small connectors to be used therewith for supplying two customers. This method is shown in the left of the illustration, where four services are distributed from the end inslator.



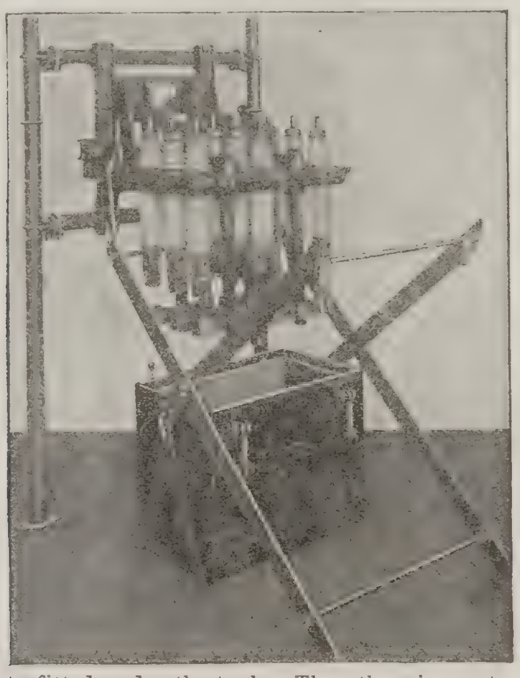
Fuseless Attachment Plug.

The Chelten Electric Company, Philadelphia, Pa., recently placed upon the market an interchangeable separable fuseless attachment plug, made of composition. This attachment plug is designed for 660 watt, 250 volts; has been approved by the Underwriters' Laboratories, and is interchangeable with other makes now upon the market.

Tank Lifters for Small Sized Oil Switches.

A tank lifting arrangement manufactured by the General Electric Company, Schenectady, N. Y., provides a simple and easy means for lifting quickly an oil switch tank either up or down the entire distance between the switch frame and the floor. The lifter is made in two widths, one for single and the other for double-throw switches, and differs only in the lengths of the three rods which join the parallel operating arms. This is necessary owing to the difference required in the dimensions of the tanks.

To fasten the tank lifter to the switch frame and lower the tank, two hooks attached to the inner ends of the longer pair of operating arms are placed over the ribs of the switch frame, the operating arms are raised and the tank



supports fitted under the tank. Then the wing nuts which secure the tank to the frame are turned to unfasten the tank, and the arms are lowered to the floor. Finally two catches on the cross rod between the inner set of operating arms are released, and these arms are raised until the tank reaches the floor.

The tank supports are separate from each other and attach to the tank by continuations of the two equal sides of each strap iron triangle, which are bent upward to fit over the rim on the bottom of the tank. Each support is removed from a tank by lifting an end of the tank a few inches from the floor and sliding the support under. To place the tank on the oil switch, the operation as described is reversed.

Improved Flush Switches.

Improvements have recently been made by the General Electric Company, Schenectady, N. Y., in the design of their flush switches. The corners of the porcelain boxes

have been rounded, making the binding screws more accessible and the boxes less liable to breakage when the switches are installed. The walls of the boxes have also been considerably strengthened without increasing the overall dimensions of the switches.

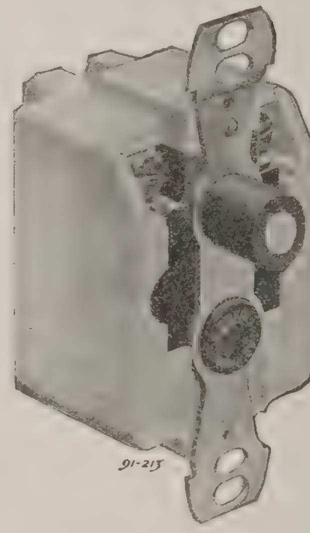
A fiber dust cover is now permanently attached, effectively closing all openings to the mechanism, but interfering in no way with the wiring of the switch. Adjusting nuts are furnished with each switch.

Holding-down screws are pointed, making it easier to locate holes in the outlet boxes and to enter the screws.

The "Capax" Switch.

The Perkins Electric Switch Manufacturing Company of Bridgeport, Conn., has put on the market a new two-button push switch, which is known as the "Capax" switch.

The switch is thoroughly substantial and the action is positive and quick, while the movement of the buttons is



less than seven-sixteenths of an inch—the out-button projecting only one-half an inch beyond the face plate. A fibre shield, to protect the mechanism from dust and dirt during and after installation, and until the face plate is applied, is permanently secured in position by the supporting yoke.

The switch is rated 10 amperes, 125 volts; 5 amperes, 250 volts; National Electrical Code Standard and labelled.

Selling Current From High Tension Lines.

Many high tension transmission lines pass through districts in need of electric service, and central station managers now realize that under proper conditions many profitable loads can be secured.

From the standpoint of operation such service must not only prove profitable, but the type of outdoor sub-station must be such that it will meet the following conditions:

1st. It must not interfere with the operation of the main lines.

2d. Disturbances at sub-stations caused by short circuits, overloads or lightning, must be localized and not permitted to communicate.

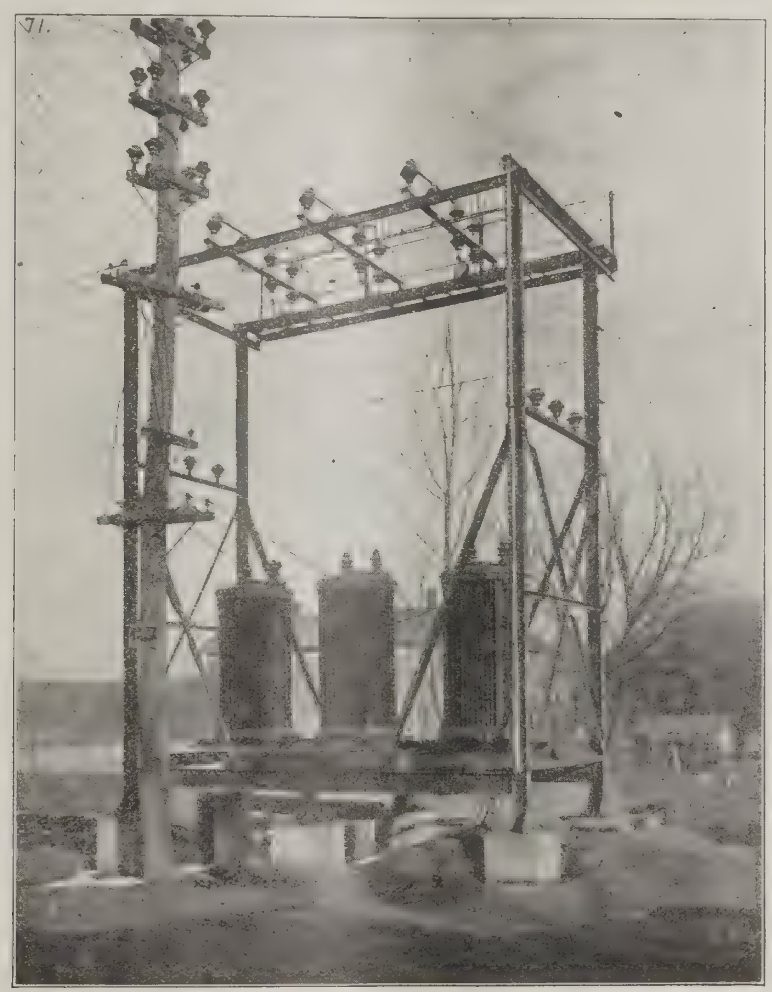
3rd. The sub-station cost per kilowatt must be low, so that the installation will return a profit.

4th. All essential elements must be in plain sight so that their conditions can be noted without difficulty or danger.

5h. The installation must be safe, easily operated, and fireproof, if possible.

That these conditions can be met is evidenced by the large number of outdoor sub-stations now in commercial service.

A new form of high capacity self-contained outdoor sub-station manufactured by the Delta-Star Electric Company, Chicago, is shown herewith. The design is such that as the demand for current increases, larger transformers can be installed without any change, except increasing the fuse capacity. By means of suitable steps and top platform rack, a lineman can easily, safely and quickly inspect the equipment and make adjustments.



New Cutler-Hammer Phase Failure Device.

A new compact type of phase failure relay, shown in the accompanying illustration, has been developed in the engineering department of The Cutler-Hammer Mfg. Co., Milwaukee. This device is suitable for use on any system similar to a vertical motor having a two or three phase stator winding and a squirrel cage rotor winding. The rotor shaft extends at the top, and to this extension a casting is secured carrying contacts designed to close a pilot circuit which controls the motor starter. This phase failure relay provides against abnormal drop in voltage, against failure of one of the phases, and against reversal of the phases.

If the supply voltage falls below about 70 per cent of normal the relay opens the control circuit of the motor controller and keeps it open until the line voltage returns to at least 85 per cent of normal. The limits can be adjusted before shipment to suit special conditions.

In case of phase failure, caused by the opening of one of the supply lines at any point, the relay opens the control circuit if the motor is under appreciable load, and keeps it open until the fault is corrected. If the load on the

motor is very light, so that no harm would result from its running single phase on account of the phase failure, the device may not operate until the load is increased or the motor shut down. If the motor is at rest at the time of phase failure the relay will act immediately. Thus the motor is allowed to run as long as no damage can result.

In case of phase reversal the relay opens the control circuit immediately and keeps it open until the phases are reconnected in the proper order.

Telephone Cable in China.

Lead covered cable is used quite extensively for outside telephone plant work in those cities of China where any considerable amount of telephone service is given. In the illustration, the main picture shows the cable laid as it was done in one of the streets of Changsha; the insert at the left pictures cable splicers at work in a man-hole and that on the right, the method of splicing submarine cable.

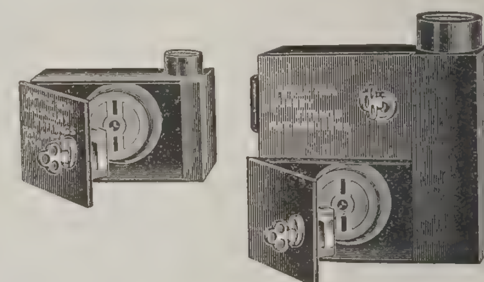
This work has been done under the direct supervision of experts from the Western Electric Company, New York City, the manufacturers of the cable.

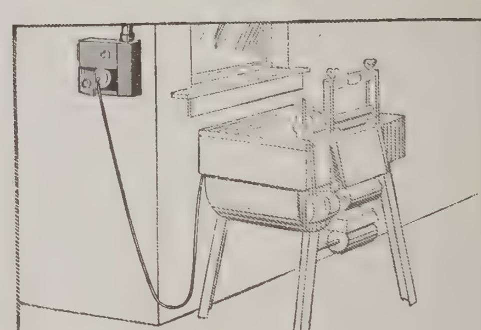
New Appleton "Unilet" Fittings.

The Appleton Electric Company, Chicago, Ill., is putting out a new line of "Unilet" fittings which will, no doubt, fill a long felt want in apartment buildings where it is desired to keep the different tenant's current separate.

The one, two and three gang fittings shown are designed for use in laundries of apartment buildings. They are furnished with locked covers so that each tenant holds the key for their respective outlet used to supply the current for a washing machine or flat-iron circuit.

These fittings are drawn from steel and furnished with either black enameled or sherardized finish. The gang fittings are furnished with partitions and the back of each compartment is drilled and tapped for the supporting screws of a receptacle for attachment plugs. The drawing shows a two-gang fitting installed and attachment made for a washing machine.





What to Buy and Where--Told in Catalogues Just Issued

The following catalogues have just been published by the companies named, and can be secured without charge by writing to the addresses given. Many of these catalogues contain data you will value.

Number.	Name.	Company.
402.	Mechanical Devices	Fargo Mfg. Co., Inc., Poughkeepsie, N. Y.
700.	Electrical Devices	Fargo Mfg. Co., Inc., Poughkeepsie, N. Y.
800.	Mechanical Devices	Fargo Mfg. Co., Inc., Poughkeepsie, N. Y.
740.	Leaflet, High Tension Equipment	Delta-Star Electric Co., Chicago, Ill.
51.	Oamco Light Reflectors	Overbagh & Ayers Mfg. Co., Chicago, Ill.
53.	Oamco Street-Lighting Fixtures	Overbagh & Ayers Mfg. Co., Chicago, Ill.
1000.	Direct Current Motors	Eck Dynamo and Motor Co., Belleville, New Jersey.
B-3301-3.	How our House is Wired	Edison Lamp Works, General Electric Co., Harrison, N. J.
1-3337.	The Illumination of Billboards by Edison Mazda Lamps	Edison Lamp Works, Gerenal Electric Co., Harrison, N. J.
	A Testing Service	Electrical Testing Laboratories, Inc., New York City.
	Wall Hanger of Push-Buttons and Sockets	Cutler-Hammer Mfg. Co., Milwaukee, Wis.
	O.-B. Bulletin	Ohio Brass Company, Mansfield, Ohio.
	Carbo Steel Poles	Carbo Steel Post Co., Chicago, Ill.
	Type H Resistance Starting Switch	Allen-Bradley Co., Wilwaukee, Wis.
42552.	Motor-Generator Sets	General Electric Company, Schenectady, New York.

Foreign Trade Opportunities.

The United States Department of Commerce reports the following opportunities for trade expansion:

Lighting plant and tramway system, No. 16950.—The commercial attache of the Department of Commerce in Chile transmits a report relative to an opportunity for the sale of machinery and supplies for an electric-lighting plant and tramway. Copies of this report may be had on application to the Bureau or its branch offices.

Magnetos, No. 16890.—A firm of engineers in England writes an American consular officer that it desires to be placed in communication with American manufacturers of magnetos to be used in connection with large gas engines, from 100 to 1,000 horsepower. Specifications with illustrations and drawings should be sent at once. The firm desires to secure an exclusive agency.

Water turbines, No. 16893.—A firm in Honduras informs an American consular officer that it wishes to secure prices and descriptive catalogues for small water turbines for electric plants. Prices and weights should be stated f. o. b. New York and New Orleans. Copies of catalogues, etc., should be sent to the consular officer.

Steel and copper wire, tools, and machinery, etc., No. 16891.—A firm in Italy has requested an American consular officer to place it in communication with American dealers, Manufacturers, and exporters of steel and copper wire, varnish, tools for the mechanical industry, woodworking machinery, and shoes, with a view to securing exclusive agencies for these lines. Correspondence may be in English.

The United States Department of Commerce reports the following opportunities for trade expansion:

Lighting plant and tramway system, No. 16950.—The commercial attache of the Department of Commerce in Chile transmits a report relative to an opportunity for the sale of machinery and supplies for an electric-lighting plant and tramway. Copies of this report may be had on application to the Bureau or its branch offices.

Magnetos, No. 16890.—A firm of engineers in England writes an American consular officer that it desires to be placed in communication with American manufacturers of magnetos to be used in connection with large gas engines, from 100 to 1,000 horsepower. Specifications with illustrations and drawings should be sent at once. Teh firm desires to secure an exclusive agency.

Water turbines, No. 16893.—A firm in Honduras informs an American consular officer that it wishes to secure prices and descriptive catalogues for small water turbines for electric plants. Prices and weights should be stated f. o. b. New York and New Orleans. Copies of catalogues, etc., should be sent to the consular officer.

Steel and copper wire, tools, and machinery, et., No. 16981.—A firm in Italy has requested an American consular officer to place it in communication with American dealers, manufacturers, and exporters of steel and copper wire, varnish, tools for the mechanical industry, woodworking machinery, and shoes, with a view to securing exclusive agencies for these lines. Correspondence may be in English.

X-ray equipment, No. 16897.—An American consular officer in Central America reports that a hospital in his district is considering the installation of a small X-ray equipment. Catalogs, price lists, etc., should be sent at once.

Ice-plant machinery, No. 16889.—A company in Honduras informs an American consular officer that it wishes to secure catalogs and price lists and full information relative to the cost of installation, cost of production of ice, approximate shipping weight, crated for export, and prices f. o. b. New York or New Orleans for ice-plant machinery. Plants of 1-ton capacity and less, for gasoline engine or electric power, are in demand. Catalogs, etc., should also be sent to the American consular officer.

Ice machinery and bottles, No. 16968.—An American consular officer in Honduras reports the name of a man who desires to investigate ice-making machinery for a plant of 1 ton or more capacity. The consular officer states that the man is a manufacturer of soda water, and that he may be induced to purchase American bottles with metal corks.

FRANCE.

The incapacity of French state departments in the management of technical affairs seems as chronic as ever and stands in painful contrast to the equally remarkable enterprise and efficiency of German officialdom. The proposed tax on lamps and energy for lighting is meeting with justifiable indignation. In addition to its monopolies in matches, tobacco and telegraph and telephone services, the State now proposes to monopolize telephone supplies, whence, of course, a farther storm of industrial indignation.

SCANDINAVIA.

Scandinavia is, above all, the home of hydro-electric and electro-chemical and metallurgical development in Europe, and by the magnitude of the schemes now in hand or under consideration, her priority is likely to remain long unchallenged. The waterfalls owned by the Swedish State represent about 700,000 H. P. and the electrification of the greater part of the state railways is being carefully considered. Electric furnaces are being rapidly developed, not only because of their inherent merits, but also under the stimulation of rising charcoal prices. By the end of this year, one firm hopes to have in operation four electric furnaces each consuming 12,000 H. P. and yielding 30,000-35,000 tons output per annum. The exceptional drought of the past summer has seriously inconvenienced some of the hydro-electric stations and the price of wood pulp had to be temporarily advanced owing to shortage of water at the mills. The electrical reduction of iron ore in Norway involves, in two plants alone, long term contracts for 30,000 H. P. at an average price of $6.90 per horsepower year an annual output of 25,000-30,000 tons of iron and steel billets.

AUSTRIA-HUNGARY.

The dry summer has unexpectedly expedited the completion of the Innsbruck-Kurwendel electric railway; all the tunnel sare now cut and the line is expected to be out of the contractors' hands by October, 1912. A large central station is to be laid down in Budapesth and the demand for cables in this locality has justified the Ganz Co., in erecting important works in the city. It may interest your readers to learn that it is usual for tram-passengers in Prague to give the conductor a tip equivalent to two cents with each fare to augment their official salary, which varies over the range of $193-$225 per annum during the first 11 years service.

RUSSIA.

German subsidiary companies in Russia continue to report good progress, though the autocratic regulations and conduct of the authorities considerably restrict developments. The war-ozonising plant at St. Petersburg treats 11 x 10^6 gallons per diem and is the largest equipment yet in use.

INDIA.

The Tata hydro-electric development in Bombay is of great preesnt and future importance and is remarkable as being financed and operated almost exclusively by native capital and labor. Metallic filament lighting has been installed at the famous temple of Kali, (Kalighat), after a weighty discussion by the priests as to its propriety. The Coronation Durbar has involved a vast amount of electrical work, but much of the equipment is merely to serve a temporary purpose.

SOUTH AFRICA.

Electric power continues to make steady progress on the Rand and in industrial and domestic applications in all the large towns. A wide telephone development is reported in rural or farmer service as well as in commercial and urban work.

NEW ZEALAND.

Vast hydro-electric developments are on foot, though the tremendous proposals outlined by a certain Minister early in the year cannot be regarded as more than political phantasmagoria.

In concluding this review of electrical developments in 1911, the writer would at once disclaim any pretensions to completeness. In so vast a field it is more than difficult to essay a well balanced review even of the more important developments, but, if he has called the attention of the reader to a few points which had escaped his notice, advised him of some of the advances in fields other than his own and, above all, led him to extend somewhat his acquaintance with the foreign press, this space will have been well expended.

Industrial Items.

THE HOYT ELECTRICAL INSTRUMENT WORKS, Penacook, N. H., announce the appointment of Mr. Ernest M. Hobbs District Sales Manager with headquarters at 967½ Woodward, Ave., Detroit, Mich.

THE CHELTEN ELECTRIC COMPANY, INC., of Philadelphia, furnished all of the plug receptacles used in the new Hotel Traymore, Atlantic City, N. J.

THE COLORADO ELECTRIC LIGHT & POWER RAILWAY ASSOCIATION will hold its Thirteenth Annual Convention at Glenwood Springs, Colo., September 23rd, 24th and 25th, 1915.

THE ECONOMY SERVICE CONNECTOR CO., Coffeyville, Kans., is preparing to put on the market an "Economy Service Connector." This device was designed to fill a want found in an experience of fifteen years as central station manager.

THE WAGNER ELECTRIC MANUFACTURING COMPANY of St. Louis announces the opening of an office in the Walker Bank Bldg., Salt Lake City. The office will be in charge of Mr. F. C. Morton, who for many years has been identified with the sale of electrical apparatus in that territory.

THE INTERNATIONAL JURY OF AWARD of the Panama-Pacific International Exposition has completed its work of judging exhibits in the Palace of Manufacturers, and announces that it has awarded the following medals to the Western Electric Company. The Grand Prix for the exhibit as a whole. Gold Medals each were awarded as follows: One for telephone switchboards and equipment. Another for telephone train dispatching and control apparatus. A third for insulated wires and cables. Two bronze medals were awarded for the company's mine rescue equipment and mine telephones. Silver medals were awarded to the following manufacturers of electrical devices with the distribution of whose products the Western Electric Co. is closely identified. These companies had their products displayed in the Western Electric Company's exhibit.

To the American Electrical Heater Company for electric irons; to the Gray Pay Station Company for telephone pay stations; to Edwards and Company for annunciators. To Conlon Washing Machine Company for Western Electric-Conlon washing machines.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., has been awarded a gold medal by the International Jury of Award, Panama-Pacific International Exposition for its exhibit of a complete line of electric wires, cables and cable accessories.

THE TURNER ELECTRIC SUPPLY COMPANY for eight years located at 18-20 S. Twentieth Street, Birmingham, Ala., has moved into a new three story and basement building at 2104 First Ave., in the same city.

THE ENTRANCE OF THE PREST-O-LITE COMPANY, INC., of Indianapolis, Ind., into the electric lighting field has just been announced. The company is now manufacturing the Prest-O-Lite Storage battery. The company states that its new interests will in no way interfere with the extension of its business in the Prest-O-Lite acetylene system.

The Pelton Water Wheel Company has a very interesting exhibit at the Panama-Pacific International Exposition, to which they cordially invite engineers who are interested in hydro-electric machinery.

The Main Electric Manufacturing Company is now comfortably housed in their new plant, located on the main lines of the Pennsylvania R. R., Pittsburgh, Pa., where they have a private siding to take care of their increasing business. They have over three times the space they had previously, and before long they will need all of it as they find business fine all over the country, as it has been for the past three months.

The Sangamo Electric Company announces the removal on Jan. 1st of its office at Rochester, New York, to the Mercantile Building.

The National Electric Controller Co., formerly of 1110 West Lake Street, Chicago, Ill., has removed to 154 Whiting Street, same city.

The first four sections, comprising about 47 miles, of the oil pipe line for the Valley Pipe Line Company of California, a subsidiary of the Shell Royal Dutch Company, which was designed and is being built by Sanderson & Porter, was placed in successful operation on May 15th. This line is 170 miles long, extends from the California oil fields to a tidewater terminal near Martinez in San Francisco Bay, and will have a carrying capacity of 25,000 barrels per day. In order to comply with the wishes of the Shell Company for prompt completion, the construction engineers, Messrs. Sanderson & Porter, pushed this work through in what is believed to be record time.

The storage capacity at the pumping stations now in operation on this first section of the line amounts to 225,000 barrels, which is thus made immediately available for the storage of surplus production.

Power Line to be Extended to Monroe.

Gainesville, Ga.—Work was begun this week on the new tower line from Gainesville to Monroe, 45 miles below Gainesville. The line is being built by the Georgia Railway and Power Company, and will furnish light and power to a number of towns between the two places, which have not heretofore had electricity.

The power will be generated at Tallulah Falls and Chattahoochee Park.

Plans are under way to celebrate "a national electrical week." The date will probably be set some time during the spring of 1916.

Electrical Construction News

This department is maintained for the benefit of contractors, dealers, manufacturers and consulting engineers.

MUSKOGEE, OKLA. A committee of five prominent business men of the city has been appointed by the Greater Muskogee Association to work out a feasible plan for building a dam across the Grand River between Muskogee and Fort Gibson to generate hydroelectric power. A number of plans for financing the project have been submitted by the financiers and promoters and some offers to build the dam under various concessions to be granted by the city have been received. A complete survey has been made and plans and specifications containing profiles and estimates are in the hands of the Committee. The approximate cost of the dam will be $750,000.00.

SAN ANTONIO, TEX. Commissioner Lambert is considering plans for utilizing the water of the San Antonio River as it passes through Brackenridge Park to generate electricity for lighting the park.

GUNTERSVILLE, ALA. The Alabama Power Co., will build a steam power electric plant in Guntersville and later will extend the transmission systems from Gadsden to Guntersville to furnish Albertville, Boaz and intervening points with electric power.

KAPLAN, LA. It is reported that the installation of a municipal electric lighting plant is under consideration.

AUSTIN, TEX. $125,000.00 has been appropriated by the Legislature for improvements at the State Capitol, including power and heating plants, rewiring and plumbing. For information address T. Owens, Supt. Public buildings and grounds.

BROMIDE, OKLA. The installation of a municipal electric light plant in Bromide is under consideration.

HAZARD, KY. E. C. Lilly of Bluefield, West Va., and D. Terpstra of Norton, Va., contemplate constructing a large central electric power plant to supply electricity for coal mining development in the Hazard field.

ORANGEBURG, S. C. Bonds to the amount of $15,000 have been voted for improvements to the electric-light plant.

NICHOLS, GA. The Public Utility Company of Waycross, Ga., will install an electric light plant and water works at Nichols. It is estimated that the works will cost approximately $20,000.00. Definite plans will be ready in about 90 days.

MEMPHIS, TENN. The City Commission has adopted a resolution to exercise its option to take over the plant of the Merchants' Power Co. on January 1st, 1916.

FULLERTON, KY. John Davis, who recently purchased the plant of the Fullerton Canning Co., is reported to be about to install an electric light and ice plant.

EL RENO, OKLA. The El Reno Gas & Elec. Co. is about to extend its transmission lines to supply electricity to the Cheyenne & Arrabahoe Indian Agency; El Reno Brick Co.; Rock Island Pumping Station and Fort Remount Station.

KENEFICK, OKLA. The City Council is considering the installation of an electric light plant. It is reported from the same city that a franchise has been applied for. Full information can be had from the Mayor.

KAW, OKLA. Preparations are being made for the installation of an electric lighting plant in this city.

MISSISSIPPI. The Mississippi Valley Ry. & Power Company with a capital stock of $500,000.00 has been incorporated. Harry W. Davis of the Delaware Trust Company, Wilmington, Del., Vice Pres.

HINDMAN, KY. On July 15th the City voted on $200,000.00 bonds to construct an electric light and power plant. The matter is in charge of the Mayor.

SALISBURY, N. C. The Southern Power Co. will begin work at once on the erection of a steel tower and electric transmission line from Salisbury to Statesville. It is also probable that the company will rebuild the line between Salisbury and Charlotte replacing the wooden poles with steel towers as soon as the line to Statesville is completed.

JENKINS, KY. It is reported that the city has granted a franchise to construct an electric power plant. Address the Mayor.

George Simon Ohm was a founder of the science of treating electricity by mathematics. His name is one of those which will endure as long as the art. His law is a part of every electric measurement. Ohm was a German.

Illumination by Ornamental Luminous Arc Lamps Panama-Pacific International Exposition.

The illumination of the Panama-Pacific International Exposition transcends all previous efforts of the kind, both in magnitude and grandeur, and marks an epoch in the science of lighting and art of illumination. But few of the many thousands of visitors realize that all this great flood of light from concealed sources was worked out scientifically in its entirety to secure the proper selection and arrangement of lamps for this marvelous expression of illuminating art.

Different lighting units of the General Electric Company are used to accomplish the results desired, including the Mazda incandescent lamp, the seachlight or projector and the ornamental luminous arc lamp. For interiors thousands of Mazda lamps furnish the light, which shines through colored panes of glass and gives the buildings the cheerful appearance of being inhabited. Mazda lamps also produce practically all the exterior lighting in the grand courts among the exhibit palaces and the interior and exterior lighting of the Amusement Zone. All the towers are illuminated by searchlights or projectors, concealed on the roofs of the surrounding buildings. Searchlights are likewise the source of light in the scintillator, which floods the sky over the exposition with light of varying color thrown on clouds of smoke and jets of steam.

The nine main enormous exhibit palaces in addition to Festival Hall, Horticultural Palace and the Service Building have their outer walls illuminated by ornamental luminous arc lamps. The lamps are concealed behind translucent banners of artistic heraldic design and plaster shields. The banners are placed partly around the lamps and are of such a density to allow just enough light to pass through to show their designs and colors, while the greatest flood of light is reflected directly against the walls of the buildings.

The general lighting scheme was designed by Mr. W. D'Arcy Ryan, chief of illumination, and the details were worked out by himself and his assistants in the illuminating laboratories of the General Electric Company, of which he is the illuminating engineer. From the beginning the idea was to have the lighting arranged so as to give one walking through the avenues the impression of being in a theatre. The buildings, the shrubbery, the flowers and the trees represent the stage, and there is no detail of architecture that cannot be seen with equal enjoyment by night as well as by day. All the true colors of the flowers and trees surrounding the buildings are brought out by the clear white light of the ornamental luminous arc lamp. This white light has also been employed to express in their true colorings the beautiful soft tints and delicate shades that were selected by Mr. Jules Guerin, chief of color, for the building exteriors.

Instead of being mounted on single-lamp standards, the ornamental luminous arc lamps are grouped. Some standards have two, three, five, seven and nine lamps each. These standards, of artistic design, are of different heights, from 25 to 50 feet, to correspond to the height of the walls of the buildings they are lighting. The spacing of the standards ranges from 50 to 65 feet, in conformity with the area lighted and intensity desired. Solid wooden poles support the framework or crossarm on which the lamps rest. A groove is cut in the side of each post for imbedding the cable, after which the opening is closed by strips of wood. About 900 lamps are in operation at the present time, each circuit containing approximately seventy-five lamps.

The Band Concourse is an open-air resting place where daily band concerts are given. This large space is also lighted by ornamental luminous arc lamps, with leaded glass shades surrounding the globes. There are five lamps to each post, four at one level and the fifth in the center a little higher up. These standards are of attractive design and make as fine an appearance in the daytime as at night. East of the Palace of Machinery in a large freight yard are eight more of these five-lamp standards, without the leaded glass shades. These lamps burn all night and aid very much in unloading cars.

There are several lessons to be learned from this style of lighting. One in particular is that grouping lamps is of great advantage for accomplishing certain illuminating results. There are places in many cities where this arrangement could be used effectively. On streets or sections of streets that are exceptionally wide, say 100 feet, or more, two or three-lamp posts can be used to better advantage than single-lamp posts, placed so as to try to secure adequate illumination. Often public buildings are set back from the curbing a considerable distance, and one or two extra lamps on posts in such localities will bring out the buildings with the desired prominence. At street corners or in parks there are a great many instances where as many as five-lamp standards should be recommended.

It is not necessary to use banners of shields for lighting streets in the same manner as had been done at the exposition. In fact, there will be very little occasion to use such decoration in a city, unless it should be in some section where it would be appropriate and effective to display the city or state seal, or some figure symbolic of local progress.

If a man's heart is in his work he does a good job. Some men need a change of heart. He lives best who can awake each morning with enthusiasm for the work at hand.

The Central of Georgia Railroad Company and Merchants and Miners Transportation Co., use electric trucks in handling freight on their docks about 50 trucks being in service.

ELECTRICAL ENGINEERING

THE NATIONAL JOURNAL OF

Electrical Practice

Issued Monthly by Technical Journal Co., Inc.
1642 Woolworth Bldg., New York
Chas. B. Thompson, President
Wm. F. Eastman, Vice Pres.

SOUTHERN OFFICE, GRANT BLDG., ATLANTA, GA. *CHICAGO OFFICE, 651 MARQUETTE BLDG.*

Telephones: New York, Barclay 7448; Chicago, Central 3792

Volume 47 SEPTEMBER, 1915 Number 9

CONTENTS

SUBSCRIPTION PRICE—United States and Possessions, Mexico and Cuba $1.00 a year. Canada $1.50 a year. Foreign Countries in Postal Union $2.00.

CAUTION—Do not pay solicitors, unless they present *written authority*, with date, from the publishers to collect money.

NOTICE TO ADVERTISERS—To insure insertion, all copy, cuts, etc., for changes of regular advertisements in ELECTRICAL ENGINEERING should reach us NOT LATER than the 15th OF THE MONTH preceding date of publication; three days earlier if proof is desired. The first advertising forms close promptly on this date.

NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 20th.

Recognized Organ of the Southern Trade. *Member Audit Bureau of Circulation.*

Entered at the New York Post Office as Second-class Mail Matter.

This Issue, 10,000 Copies

ELECTRICAL ENGINEERING

THE NATIONAL JOURNAL OF

Electrical Practice

Technical Journal Company, Inc., New York

Vol. 47 SEPTEMBER, 1915 No. 9

Selecting a Street Lighting System

By David R. Shearer

THE growth of the use of incandescent lamps for street lighting has been very rapid and great advances have been made in the design of fixtures for this purpose and in the increase of economical light production from incandescent sources by improvement in lamp design. Formerly the arc lamp was considered by far the best for street lighting purposes either in multiple or in series although in modern practice the series arc is used almost exclusively on account of its more economical current consumption and its operation on the wire. Since the improvements in incandescent units have made its form of light fully as satisfactory and perhaps more economical than any other type of lamp, such systems have come into very general use and in many instances have displaced the series arc completely.

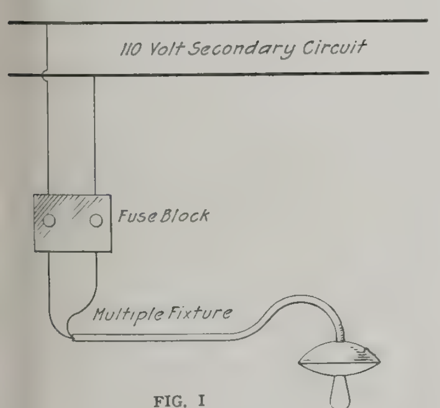


FIG. I

Perhaps the first form in which we find an incandescent system used for street lighting is one of the multiple type in which the single units were fed directly from 110 volt secondaries of the town network. In some cases fuse blocks were used at the base of the lighting fixtures while in other cases no fuse blocks whatever were used and any short circuit in the fixture would seriously inconvenience the secondary lines on which it was placed. Although the first cost of such an installation is low, it is subject to many bad features. Some of them are, that the lights can not be controlled directly from the power house or sub-station but must burn at all times when the secondaries are alive unless controlled by individual switches at each fixture and this of course necessitates quite an amount of labor and the covering of the whole town by a man whose duty it is to turn the lights on and off.

We next find the series incandescent lamp in use on series arc circuits at certain points where a small amount of light only is required and an arc would prove uneconomical in operation. At first all of these series lamps were of the carbon filament type, furnishing a light of a yellowish or redish tinge and requiring from three and a half to five watts per candle power. The fixtures and reflectors were crude, inefficient and weak meechanically. The fact that these carbon series lamps came into general use on arc circuits was unfortunate in that it gave the incandescent lamp a rather bad record for street lighting work. mAlthough some of these lamps are still in use they are rapidly being replaced with the more modern higher efficiency types.

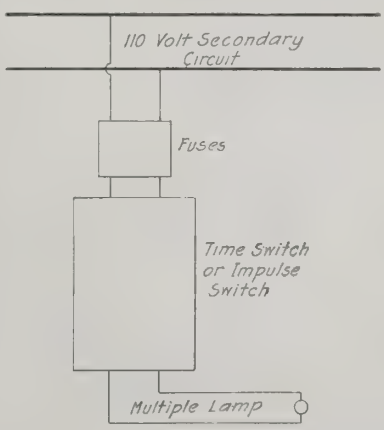


FIG. 2

Several systems are now used for securing efficient street lighting with incandescent lamps. Multiple lamps

are still used for this work but on an improved system of wiring and control. Usually the lamps are tapped on to

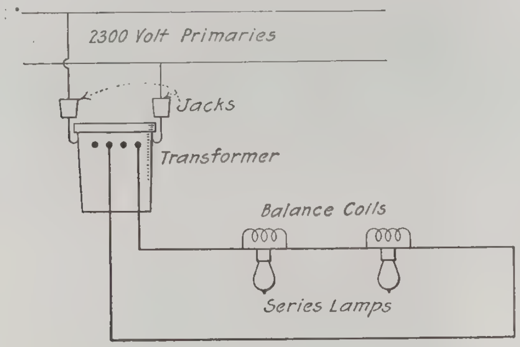


FIG. 3

the net work secondaries through a fuse block and time switch or else are controlled in circuits from convenient points, as in Fig. 1.

The latest development in multiple street lighting is the use of a small solenoid switch placed on each lamp or circuit of lamps which lights and extinguishes the lamp and is controlled by impulses sent out over the primary lines from the power house, as shown in the diagram of Fig. 2. A system of this kind, when using tungsten lamps and improved reflectors of an efficient shape furnishes an excellent light but is subject to one disadvantage, the fragility of a high voltage lamp filament.

Since the series lamp has a very heavy filament it is admirably suited to withstand vibration from street traffic and wind without injury. The use of a series lamp, however, presupposes a current of constant value and some device must be installed which will secure this result. As a series lamp works at an efficiency of one watt per candle power or less in the large sizes, it can be used to replace arc lamps with economy. This fact leads to the substitution of such lamps and fixtures on circuits which have previously been used for arcs and upon a current furnished by an arc regulator. Very good results are secured with this form of lighting but the regulator being of somewhat delicate construction and containing mechanically moving parts requires the use of a housing to contain it and some attention is necessary each day in putting the current off and on. This mechanism, however, maintains the current at a constant value and automatically compensates for lamp outages or the addition of new fixtures to the circuit. The use of tungsten lamps on circuits of this kind necessitates some form of automatic short circuiting device placed in the lamp socket or fixture to maintain the circuit intact if the lamp should be broken or burned out.

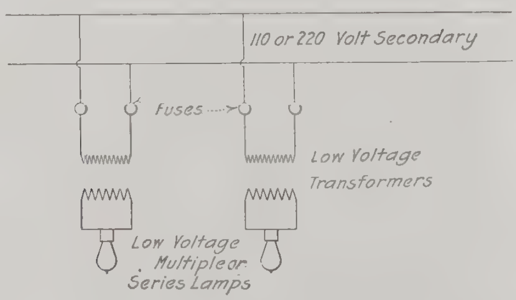


FIG. 4

We next find series tungsten lamps used on constant potential transformers which are so adjusted as to give a current of constant intensity through the entire circuit. Since the current value would rise in a system of this kind if one of the lamps should be cut out or short circuited, it is necessary to use a balancing coil of the same resistance as the lamp in place of a short circuit cut out, as illustrated in Fig. 3. Several objectional features are to be found in this system; for instance, the addition or subtraction of any lighting unit from the circuit requires a corresponding change in the transformer adjustment as does the replacing of a lamp of one size with that of a different size.

To obviate the use of compensating transformers, some systems have been installed using low voltage series lamps on multiple circuits by the addition of a small transformer to each light and fixture, as in Fig. 4. This, of course, means that each series lamp burns on its own transformer and therefore forms a complete series circuit in itself. The efficiency of such a system is not high, however, and additional difficulties are introduced because multiple circuits must be run to furnish the primary current to the small transformers.

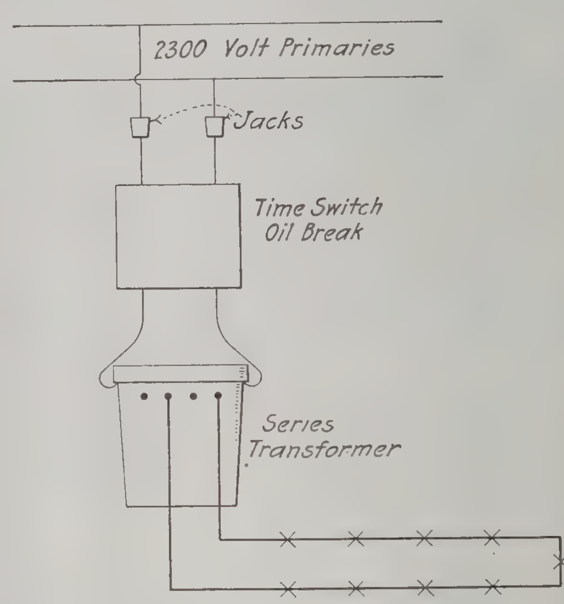


FIG. 5

Within recent years certain companies have introduced a compensating series transformer of the magnetic or phase displacement type which may be placed directly on a pole similar to an ordinary transformer. These regulators maintain a very nearly constant current, automatically taking care of lamp outages or changes in the circuit, after once being properly adjusted.

Special attention is drawn to this system. A sufficient number of these transformers are connected to the lighting primaries at points located central to the area to be lighted and each may control from twenty-five to one hundred series incandescent lamps which, of course, must be equipped with short circuiting devices, which in most cases take the form of film cutouts held between two clips on the socket. If one set of primaries are used for all these transformers all the series circuits may be lighted and extinguished from the power house with a primary oil switch or if it is not found advisable, to run a separate primary circuit to feed the transform-

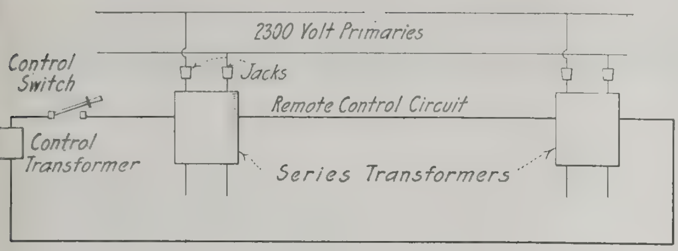


FIG. 6

ers they may be connected directly to the lighting primaries through some form of switch mechanism which governs the time of lighting. This is shown in Fig. 5. Primary time switches may be used for this purpose or remote control oil switches operated from a low voltage pilot circuit run from the power house, as in Fig. 6. A switch was designed and placed in operation several months ago for obviating many of the difficulties attending the proper control of these pole type series transformers. A high tension oil switch was operated from the power house by impulses sent out over the primary circuits, which, though sufficient to operate the switch, had a negligible effect on the lights and motors operating throughout the town. This system is illustrated in the diagram of Fig. 7.

Since the advent of the nitrogen filled lamp with efficiencies of 0.6 watt per candle power in the larger sizes, this system appears to be especially advantageous. A lamp of the gas-filled class of 500 to 1,000 candle power placed in a sturdy fixture equipped with a wave form reflector or other efficient street lighting reflector gives a light far more satisfactory and withal more efficient than an arc. These may be installed as in Fig. 8. The first cost is not so great, the lamp requires no trimming, the current consumption is small and if placed on a pole type transformer, no attention is necessary for its operation other than the regular lighting and extinguishing. Since special primaries running from the power house are not required, the series circuits may be laid out with a view to economy in wire and to the correct location of light sources regardless of distance from the central station. The pole type series transformer may then be located centrally on these series circuits and a marked economy in the use of wire and of pole line material secured. Each of these transformers and a circuit which it supplies forms a complete individual series lighting system fed from the ordinary primary leads.

Several methods of control may be used but since a time switch requires weekly winding and quite an amount

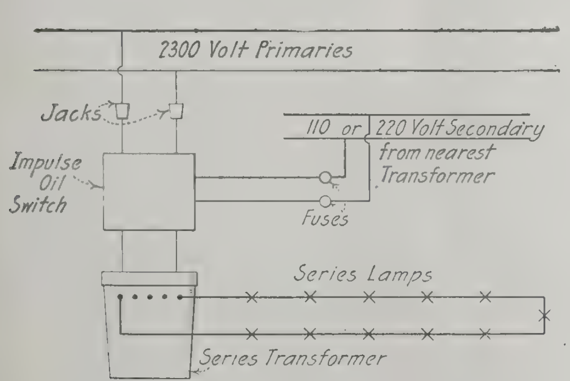


FIG. 7

of changing to compensate for the shortening and lengthening of the days at different periods of the year, other forms are probably more satisfactory. The pilot wire system, which has previously been mentioned consists in running a series control circuit from the power house and this circuit operates a solenoid oil switch at each transformer and therefore gives control of all the series lighting circuits from a main operating switch placed at a convenient point. As a usual thing current is not sent through this circuit continuously but only at those times when it is desired to turn the lights off or on. The current for operating the solenoids may be secured from a small transformer built especially for that purpose.

The method which the writer has used with satisfaction is perhaps the simplest and most inexpensive, since the impulses operating the series transformer oil switches are sent out directly on the primaries in use, without affecting the regular load. When using an installation of this type, there is practically no limit to its extension since additional series circuits, each with its regulating transformer, may be placed on any of the primaries at any point in the town and be operated at the same time

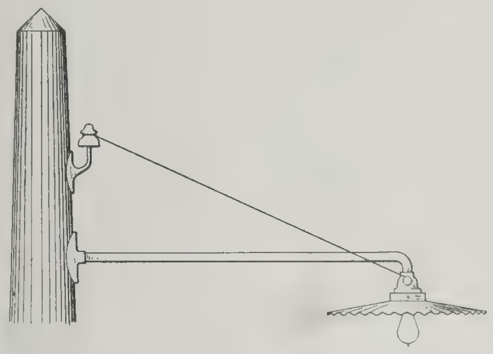


FIG. 8

and in the same manner as the lights already in use. All that is necessary is to install the local series circuit, fixtures, lamps, transformer and electrical impulse switch and the work is done. A lighting system of this kind, when used with the most improved lamps is highly efficient, furnishes a steady light of excellent quality and is easily controlled.

Municipal Plant for New Orleans

There is much interest over the announcement that the city of New Orleans, La., will build and operate its own municipal electric plant. Formerly the city had a contract with the New Orleans Railway and Light Company to supply light. The city government insisted on a new contract under which the company was bound to furnish light under a seven-cent primary and four-cent secondary rate. The company claimed that this rate was unremunerative and offered to put int oeffect a nine-cent primary and a six-cent secondary rate for 1916 with an eight and five cent rate for 1917.

As no agreement could be reached, the city decided to build a plant of its own to do commercial and power business. To this end, it has employed F. W. Ballard, of Cleveland, Ohio, who has been in charge of the Cleveland Municipal plant, to organize a corps of engineers, make a survey of the city and prepare plans for a complete municipal electric light and power generating and distribution system. The estimated cost of the plant is $6,000,000.

What It Pays To Know About Lamps

By George Dickens

As the buyer of an Electric Service Company it is my lot to receive the agents and representatives of the many firms in the field. All are eager to sell their goods, of course, but why do they tell the same old story, of best quality, quickest service, and lowest price? This thing has at times become so monotonous that I have felt almost disgusted with my position and vocation. When in this mood, and alone in my office, my thoughts ran so high that I was almost speaking aloud:

"Why don't some of these talking machines say something new, original, something interesting, worth knowing? Some don't even know the technicalities of their own line as good as I do, but still they want to make me buy."

This mental monologue was interrupted by the entrance of the office-boy announcing Mr. Smith, who wanted to talk about electric lamps. Well, "lamps" is the very last thing I dreamt of in this kind of weather; nevertheless the salesman entered and fired away.

"What do you know about lamps, Mr. Dickens?" he asked, while helping himself to a seat.

"Probably more than you can tell me," I snapped back.

"Well, let's see," returned the salesman with a smile, "I have come to tell you some things about lamps that you don't know." And this is the interesting part he told me, not only about his particular lamp, but incandescent lamps in general. Since than I have changed my opinion of salesmen, and always give them the "glad-hand," as this case proves that some are a veritable-mine-of-information:—

A considerable amount of science and scientific work is represented in the little lamp you buy for twenty-seven cents, as the ablest experts have toiled for thirty-five years to bring the incandescent lamp to its present perfection. A lamp requires over forty different manipulations and passes through as many

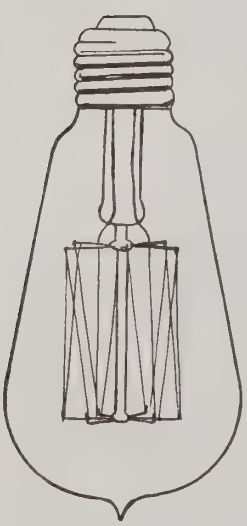


FIGURE I—STANDARD VACUUM TUGSTEN LAMP

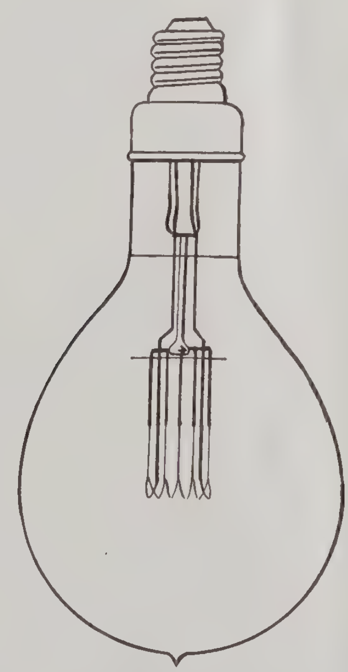


FIGURE 2—NEW (GAS-FILLED) NITROGEN LAMP

hands before it is completed; its filament is measured in thickness by trifles like thousands of a milimeter, and if one lamp differed from another in as much as one milimeter in length, it would give about 10 candlepower, more or less. The whole manufacture is built up on scientific principles, which have been found and established by long and tedious experiments. A good lamp maker, who knows his business, can time a lamp like an "infernal machine." He can make lamps last 100, 500, 1,000 and even 2,000 hours, just as he pleases. At this point the salesman took occasion to emphasize his particular make by quoting that "Lux lamps last longest" but pointed out that their lamps are timed for only 1,000 hours. The reason electric lamps are not made for a 2,000-hour duration is because that would be unprofitable to the consumer. In order to give the same light as a 1,000 candlepower lamp, a 2,000 candlepower lamp would have to have a thicker and longer filament, which would increase the resistance and consequently also increase the current consumption of the lamp. Such a lamp would consume about 3 watts per candlepower right from the start instead of 1 to 1.25 watts as do the regular lamps.

All such lamps come out alike because they are similarly timed and are made with exactly designed and cut parts. In addition, every lamp made passes a most vigorous test for uniformity before leaving the factory. If you take the time to visit and pass through any lamp works you will surely be astonished by what you see in the process of manufacture.

The tungstens used for ordinary purposes of lighting are called multiple lamps because of the system of circuit wiring. In such lamps the candlepower is partly increased by a rise in the voltage. so that with a fluctuating pressure, the candlepower will fluctuate, even an increase of only one per cent. from the normal voltage resulting in an increased candlepower of 3.6 per cent. Such operation tends to reduce the useful life of a lamp and increases the total current consumption, but the resultant efficiency of energy transformation into light is high. However, for the most economical operation, lamps should be burned at full voltage.

A standard lamp constructed according to modern practice does not extinguish itself after 1,000 hours' use but it rapidly decreases in brilliancy and increases in consumption; and that's the time to replace it with a new lamp.

An incandescent lamp designed to burn only 200 hours would naturally consume less current than a standard lamp, perhaps only one-half watt, but such designs were proven a failure about fifteen years ago, for people did not want to be bothered with renewals every 200 hours. Electric current users, classed by the central station as small consumers generally do not figure on the consumption, all they want is a lamp that will live a good long while.

The vacuum tungsten lamp is not the last perfection in lamps and has been already been surpassed by the new nitrogen or gas-filled lamp. This new lamp is made in various sizes and is now rapidly replacing the arc lamp as may be seeen by the service on the streets of any large city. These nitrogen lamps are now past the experimental stage, being almost perfect and certainly reliable.

The various lamps on the market each have a distinctive trade-name, but those manufactured by the various works of the General Electric Co. are identified as "Mazda" lamps. The standard vacuum tungsten lamp is known as Type "B," and the nitrogen or gas-filled lamp as Type "C." The Westinghouse Lamp Co. also uses this last description for their make of lamps. Interesting data on the vacuum lamp is given in Table I, whereas Table II gives similar information for nitrogen lamps, both types being illustrated by Fig. 1 and Fig. 2, respectively.

The standard tungsten or vacuum incandescent lamp may be operated successfully in all positions, but the practice with the newer form of nitrogen lamps is to install them in a vertical or almost verticl position with the tip down, though they

Volts	Watts	Efficiency, Lumens per Watt	Specific Consumption, Watts per Candle	Horizontal Candle-Power	Spherical Candle-Power in Per Cent of Horizontal	Total Lumens	Base Regularly Supplied	Dimensions: Diameter in Inches	Dimensions: Over-All Length in Inches	Hours Life
					STRAIGHT-SIDE BULB					
105 to 125	10	7.54	1.30	7.7	78	75	Med. Screw	2⅛	4⅝	1500
	15	8.52	1.15	13.0	78	128	Med. Screw	2⅛	4⅝	1000
	20	8.91	1.10	18.2	78	178	Med. Screw	2⅛	4⅝	1000
	25	9.34	1.05	23.8	78	234	Med. Screw	2⅜	5¼	1000
	40	9.52	1.03	38.8	78	381	Med. Screw	2⅜	5¼	1000
	60	9.80	1.00	60.0	78	588	Med. Screw	2⅝	5½	1000
	100	10.32	0.95	105.0	78	1032	Med. Sc. Sk.	3¾	7⅞	1000
220 to 250	25	8.27	1.20	20.8	79	207	Med. Screw	2⅜	5⅛	1000
	40	8.86	1.12	35.7	79	354	Med. Screw	2⅜	5⅛	1000
	60	9.02	1.10	54.5	79	541	Med. Screw	2⅝	5⅞	1000
	100	9.37	1.06	94.3	79	937	Med. Sc. Sk.	3¾	7⅞	1000
	150	9.93	1.00	150.0	79	1490	Med. Sc. Sk.	4⅜	8¾	1000
	250	10.45	0.95	263.0	79	2613	Med. Sc. Sk.	5	10	1000
					ROUND BULB					
105 to 125	15	8.74	1.15	13.0	80	131	Med. Screw	3⅛	4¾	1000
	25	9.57	1.05	23.8	80	239	Med. Screw	3⅛	4¾	1000
	40	9 76	1.03	38.8	80	390	Med. Screw	3⅛	4¾	1000
	60	10.05	1.00	60.0	80	603	Med. Screw	3¾	5½	1000
	100	10.58	0.95	105.0	80	1058	Med. Sc. Sk.	4⅜	7¼	1000
220 to 250	25	8.38	1.20	20.8	80	210	Med. Screw	3⅛	4¾	1000
	40	8.98	1.12	35.7	80	359	Med. Screw	3⅛	4¾	1000

TABLE I—DATA ON VACUUM TUNGSTEN LAMPS

can be manufactured to burn in any position. Special rules governing the installation of the gas-filled lamp will be found in the 1915 edition of the National Electric Code.

The list below gives manufacturers making either one or both forms of lamps and those which have "Division" in the name are a part of the National Lamp Works organization. The manufacturers having a star (*) after the name import the lamps from foreign countries whereas the others are "made in America."

OTHER LAMPS	MAZDA LAMPS
Deuth & Co.	American Electric Division
D.-M. Lamp Co.*	Banner Electric Division
Franklin Electric Mfg. Co.	Bryan-Marsh Division
Greenwich Sales Co.*	Columbia Lamp Division
Hygrade Incandescent Lamp Co.	Edison Lamp Works
Independent Lamp & Wire Co.	Fostoria Incandescent Lamp
Laco-Philips Co.*	Monarch Electric Division
Lux Manufacturing Co.*	Peerless Lamp Division
Metalyte Co.	Sterling Electric Lamp Div.
N. Y. Electric Lamp Co.	Sunbeam Incandescent Lamp
Whitehall Electric Co.	Westinghouse Lamp Co.

Another recent production is the concentrated filament lamp

Volts	Watts	Efficiency, Lumens per Watt	Specific Consumption, Watts per Candle	Horizontal Candle-Power	Spherical Candle-Power in Per Cent of Horizontal	Total Lumens	Base Regularly Supplied	Dimensions: Diameter in Inches	Dimensions: Over-All Length in Inches	Hours Life
105 to 125	100	12.57	0.80	125	80	1257	Med. Screw	3⅛	7⅛	1000
	200	13.40	0.75	267	80	2680	Med. Sc. Sk.	3¾	8⅜	1000
	300	14.36	0.70	429	80	4310	Mog. Screw	4⅜	9¾	1000
	400	14 36	0.70	571	80	5745	Mog. Screw	5	10	1000
	500	14 36	0.70	714	80	7180	Mog. Screw	5	10	1000
	750	15 47	0.65	1154	80	11600	Mog. Sc. Sk.	6½	13⅜	1000
	1000	16.76	0.60	1667	80	16760	Mog. Sc. Sk.	6½	13⅜	1000
220 to 250	200	11.97	0.84	238	80	2394	Med. Sc. Sk.	3¾	8⅜	1000
	300	12.57	0.80	375	80	3771	Mog. Screw	4⅜	9¾	1000
	400	13.23	0.76	526	80	5292	Mog. Screw	5	10	1000
	500	13.96	0.72	694	80	6980	Mog. Screw	5	10	1000
	750	13.96	0.72	1042	80	10470	Mog. Sc. Sk.	6½	13⅜	1000
	1000	13.96	0 72	1389	80	13960	Mog. Sc. Sk.	6½	13⅜	1000

TABLE II—DATA ON (GAS-FILLED) NITROGEN LAMPS

—a combination of tungsten and nitrogen lamp, which has taken ten years to develop. It is a lamp which will stand jarring, jerking, and all rough service as found in trains, trolley cars, and automobile lighting, and is best suited where excessive vibration is present.

That many people still use the old form of carbon incandescent lamps which consume about 3.5 watts per candlepower and the tantalum lamps consuming about 2 watts per candlepower, is almost incredible. but nevertheless it remains a fact. Even the arc lamp is still to be found in extensive use. This phenomenon shows how little some business people calculate and how they insist on wasting money on what they think are small things. But such conditions offer to the progressive contractors, dealer and jobber, a wide field for profitable new business.

Testing for Exciter Efficiencies

I. L. KENTISH-RANKIN

A most interesting problem, and at the same time not so simple, on account of the errors that may creep in, is that affecting the testing of exciters to determine the most economical combination for practical operation. For discussion, the question is narrowed down to a comparison between the relative operating efficiency of direct-connected and belt-driven exciters.

In the first case there is one 100 K.W. exciter set, consisting of a direct current generator directly coupled to a synchronous motor, which in practice is called a synchronous motor-generator. On the other hand, there are three 27.5 K.W. direct current generators used as exciters, and these are belt-driven from the shafts of the station alternators.

The thing to solve for is the difference in operating costs of the two systems so as to determine the relative advantages. This may be accomplished by separate efficiency tests.

In the synchronous exciter it is the commercial or over-all efficiency of the set with which we are concerned and it is not necessary to know the individual losses of the two machines, it being sufficient to measure the input and output from which the efficiency is readily obtained. In this case both the input and output are electrical, and for this reason the test is relatively simple. The synchronous motor should be used to drive the direct current generator or exciter at full load or any other useful load. In the motor circuit must be installed a wattmeter, ammeter and voltmeter for the direct current field circuit. Likewise in the generator circuit an ammeter and voltmeter for both field and armature circuits are required. Then operate the set until constant temperature is obtained, which may be found by resistanc measurements. It will be satisfactory to find the resistance of the exciter and motor fields and when these become constant it will be safe to consider the temperature of the set as constant also. Resistance readings should be taken every half hour, for the three or four hours that are required to reach constant temperature, but matters may be expedited by operating the first hour at 25 per cent. over load. When the temperature finally becomes constant the input and output must be carefully measured, the readings being taken simultaneously or nearly so. From the total input, that is, the input into the armature and field, and the output, armature and field, the efficiency is calculated.

The testing of the belt-driven exciter is not as simple, because we are concerned with mechanical input and electrical output. Two methods of test are readily available. One way is to find the individual losses in the machine such as windage, and brush and journal friction losses, by measuring the mechanical input, and then for a predetermined temperature rise calculate the I^2R losses of the armature and field, and the brush losses. From the input, and the summation of the calculated losses, the efficiency is found. The process is slow, involving several lengthy calculations. Errors are very likely to creep in, frequently being cumulative in their effect either one way or the other. Allowances must be made for instrument errors and the power consumption in them. Because many of the losses are relatively

small, accurate results can only be obtained when those conducting the test are experienced at this kind of work.

Another way that may be recommended, consists of using one motor to drive the other two exciters. By this means all the measurements involved are of larger amounts, and therefore less liable to be at fault. One of the exciters should be loaded with a mechanical brake or dynamometer and operated as a motor. Then carefully measure the input and the output, the first being electrical and the other mechanical. The motor should be operated until constant temperature is obtained, the resistance of the field winding being used as the criterion. The efficiency of this motor should be found for various loads, to 30 per cent. overload, and a curve plotted for these volues. Care must be exercised on this test because upon its accuracy depends the result of the whole investigation.

Having found the efficiency of the motor it now remains to connect it, with a belt or directly, to one of the exciters. The exciter which is being used as a generator is then taxed to its full load capacity and thus operated until the temperature becomes constant. The input and output, both electrical, are then measured. The efficiency is then obtained after correcting for the belt loss and the efficiency of the motor. After testing two of the exciters in this fashion the results should be compared and if they agree closely, or nearly so, there is no necessity to test the third exciter which has been used as a motor. If the exciters are of different types and makes all machines should be tested, otherwise the efficiency of the third machine may be taken to be that of the average of the other two machines, providing it is in the same physical condition.

The procedure outlined above may be very conveniently worked out without even interfering with the operation of the station, although the possibility of a shut-down during the test must be thought of. The exciter used as a motor should be left in position as it stands now, so that in time of trouble it would only be necessary to disconnect the belt from the test machine and place the other belt back on the turbine.

Taking up the two ways of operating. It will be found that there is a saving of from five to eight per cent. in efficiency in operating the synchronous motor-driven exciter. The synchronous motor has an approximate efficiency of 90 and the 100 K.W. generator of about 91 per cent. while the 27.5 K.W. exciters probably have an efficiency of about 89 per cent. to which must be added the loss in the belt.

The chief disadvantage of operating the synchronous-motor set in place of the three belt-driven exciters is that the excitation of the whole station is dependent upon one machine, which in turn is dependent upon the alternating current supply. If a short circuit comes on suddenly, and the voltage of the alternating current bus drops, as it will until the breakers open, on account of the rush of current, the synchronous motor will assuredly fall out of step, resulting in the complete interruption of the station's excitation. The slipping of the generators on short circuits will still further tend to knock the synchronous motor out of synchronism. And then the fact that the synchronous motor obtains its excitation from the generator which it drives still further tends toward instability during severe load changes. On the other hand, were the belt-driven exciters in use at the time of short circuit the surge on the alternating current lines would have comparatively little effect upon them. Of course, the action of a severe short circuit killing the excitation when the synchronous motor is used may be an advantage where service interruptions are not of great importance, but usually reliability is one of the chief aims of central station engineers. An induction motor instead of a synchronous motor would not be so sensitive to changes of voltage and frequency, but would have lower efficiency.

One other point comes up where the belt-driven exciters have a further advantage as referred to the amount of load carried by turbo-generators. During peak load periods it may happen that the alternators are overloaded, and at such times it may be well worth while to be able to transfer that 120 K.W. or more required for the large exciter, to the steam end of the turbine.

Edwin M. Herr

To those who are acquainted with Mr. E. M. Herr, president of the Westinghouse Electric and Manufacturing Company, it was a satisfaction to learn that he received the honorary degree of Master of Arts from Yale University at its 215th announcement. To those who are not familiar with his activities, this may serve as as introduction.

Edwin M. Herr was born at Lancaster, Pa., May 3, 1860 and

EDWIN M. HERR

began his career as a telegraph messenger and then as an operator, later becoming station master and operator at Deer Trail, on the Union Pacific Railway. While in this service he prepared for college, graduating as a mechanical and electrical engineer from Yale, in the class of 1884. After graduation he became a special apprentice of the Chicago, Milwaukee & St. Paul railway in the motive power department at West Milwackee and later entered the motive power department of the Chicago, Burlington and Quincy Railroad as mechanical draftsman and test engineer. Owing to his former experience he was finally made superintendent of telegraphs of the C. B. & Q. system, and his work in this department, especially during the Burlington strike, brought him to the attention of the operating department and led to his appointment as division superintendent of the Galesburg Division of the line. In 1890, he went with the Chicago, Milwaukee & St. Paul Railroad as master mechanic, which position he held until 1892, when he was called to the superintendency of the Grant Locomotive Works at Chicago. In 1895 he was sent to Europe by financial interests to report upon and establish locomotive works in Russia, upon the completion of which mission, he became, in 1896, general manager of the Gibbs Electric Company of Milwaukee, and shortly after accepted the position of assistant superintendent of the motive power department of the Chicago & Northwestern Railroad. In 1897, he went to St. Paul as superintendent of the motive power department of the Northern Pacific Railroad, which position he retained until 1899, when he went to Pittsburgh to take the position of assistant general manager of the Westinghouse Air Brake Company, later becoming general manager of that company. In 1905 he was appointed first vice-president of the Westinghouse Electric & Manufacturing Company, which position he occupied until his election in 1911 as president.

EDITORIAL

Get Your Share

WITH the summer time now practically over, you surely must be in good shape to meet the onrush of the bigger and better business that comes with the Fall Lighting Season. It is only natural that after the vacation period you should be prepared to work and push hard, not simply alone, but in harmony with the allied interests. The gain that can be thus made is a direct measure of your efforts, and by uniting with the other forces, your share of the new lighting business will be an assured reality.

The reason for calling this the Lighting Season may be found in the fact that the hours of the day are rapidly getting shorter, and everybody naturally thinks of lamps and lighting. In short, the extended use of artificial light must be resorted to, and in this lies the call of opportunity for the electrical contractor, dealer, jobber, central station and the manufacturer.

Most people realize that electricity as a light source is a comfort, and it is up to the electrical men to prove that this convenience is not one of mere luxury, but an actual necessity for domestic, commercial and industrial lighting equipments, on account of the economy in using electricity for such purposes. The development of high efficiency vacuum and gas filled lamps to their present state offers a field of choice suitable for almost any condition.

Simply stated, these lamps give a much whiter and brighter light for the same cost than the older forms of lamps, or if the amount of light as formerly used is sufficient, then by the use of the new lamps, it may be had at a considerably lower cost.

A field that can well be exploited to pecuniary advantage is that of show-window lighting. Every merchant realizes that window displays have an inherent advertising value, and the concensus of opinion is that they are great sellers of merchandise, and then again, the public can usually judge the progressive merchant by his form of window display. It is strange that there are so few merchants who have given any serious attention to the illumination of their windows, especially as the results to be attained can be almost directly measured by the increase of sales. Window displays, of course, lose all distinction unless properly illuminated at night and a poorly illuminated show window at once ceases to be a good sales medium.

For this purpose there are various forms of specially designed reflectors to be used in conjunction with the new nitrogen lamps, giving a remarkably pure and pleasant quality of light, and in this way attracting persons passing by on account of the individuality of the window so arranged.

The field of show window lighting is to the contractor really the means of gaining the confidence of his client, and when once this has been accomplished, it is but a simple matter to replace any antiquated interior illumination that may exist. Therefore, get after the stores in your locality and show them what can be done.

Another form of commercial lighting is the electric sign. The value of a sign and its location is perhaps overlooked by the average merchant. In practice the electric sign has no equal. When properly illuminated it immediately becomes of value as an advertising medium for being easily legible for hundreds of feet, it reaches out incessently and attracts the attention of those passing even at a distance. The electric sign may be made to conform with almost any condition of available space and service requirements. With the new sign lamps now on the market, the current used in sign lighting may be reduced even with a gain in distinction of the sign proper. Thus there is a field for not only installing new signs, but for selling the new lamps as substitutes for the old, and any progressive merchant will be quick to consider such change, especially as it involves no change in the existing wiring system.

This practically covers the field of commercial lighting. However, there remain many homes to be wired for electric light and many industrial establishments that have to be brought up to-date on account of the expensive and inadequate systems with which they are now equipped.

The means for securing trade of this nature may be summed up as co-operative action, which, when properly carried out, will give those electrically concerned their share of the business, and the consumer not only comfort, but economy in operation.

The manufacturers do their primary share by carrying on advertising campaigns in the popular periodicals and the daily newspapers; central stations with their commercial departments are continuously educating the public to economies that may be gained by the use of electricity for light, heat and power, and as it is their purpose to sell energy, they co-operate with the contractor in sending all customers to place the installation work with him. Then it is up to the contractor to patronize the jobbers and dealers, who in turn, rely on the manufacturers of electric appliances and equipment. There are many ways in which this co-operative work accomplishes results daily, and such methods are in fact, too numerous to mention here.

Now then, in order to get your share of the business which comes with the Fall Lighting Season, every man in the trade and industry must act—you cannot rely upon the other chap to do the work for you because if every one held that attitude, nothing would be accomplished. Every man must do what he can, and all must work together, and in this way you will get your share.

Arguments Against Light

IF any man tried to argue against the use of artificial light in the present stage of development, it would perhaps be attributed to his weakness of mind. Still it is a fact that the extensive use of electric lighting systems for street illumination has only within recent years gained its popularity. Now in the smallest of towns there may be found a more or less extensive system for the lighting of the public highways, the subject being of great moment even to the municipal authorities.

The earliest form of street lighting dates back to the time when the pedestrians carried with them either lamps or torches, and later such contrivances were suspended from the fronts of houses. The introduction of artificial gas, made possible a more permanent form of illumination, but in 1877 the use of the open carbon electric lamp was made a reality.

This latter form of electric lighting soon became popular, even in the face of the difficulties encountered by the pioneers that made gas lighting possible. Ward Harrison* has recently brought to light some documentary evidence, dating back to 1816, showing the forceful opposition then put forth against gas for street lighting, and the more interesting paragraphs are given below:

1.—From the theological standpoint: Artificial illumination is an attempt to interfere with the divine plan of the world, which has preordained darkness during the night time.

2.—From the juridical standpoint: Those people who do not want light ought not to be compelled to pay for its use.

3.—From the medical standpoint: The emanations of illuminating gas are injurious. Moreover, illuminated streets would induce people to remain later out of doors, leading to an increase in ailments caused by colds.

4.—From the moral standpoint: The fear of darkness will vanish and drunkeness and depravity increase.

5.—From the viewpoint of the police: The horses will get frightened and the thieves emboldened.

6.—From the point of view of the common people: The constant illumination of streets by night will rob festive illuminations of their charm.

No Sir!

THE "Questions and Answers" column has not been discontinued. It is too valuable a department to be disposed of in an abrupt manner without proper notification. However, the old caption has been dropped. All problems, commencing with this issue, will now be treated under the nomenclature of Problems In Electric Practice. This is an attempt to improve the service of this section and we therefore expect to hear from you telling us how you do or don't like the change. At the same time send along either a problem or a solution to one, thus helping yourself or another fellow, as the case may be.

Readers of other departments in this issue are also invited to write us freely expressing their opinions of our efforts to improve the character and make up of Electrical Engineering as a whole. It is the aim of the publishers to make Electrical Engineering a National Journal of *Electrical Practice* and towards this end we will endeavor in every way possible to warrant your co-operation.

Personals

Mr. Robert K. Sheppard, formerly manager of sales for the insulated wire department of the B. F. Goodrich Company is now associated with the Simplex Wire and Cable Company as sales manager.

A. Hall Berry, of 97 Warren Street, New York City, is the sole agent for the Sun Ray Electric Heating Pad, manufactured by the P. & B. Manufacturing Company of Milwaukee, Wisconsin.

M. L. Hibbard, General Manager of the Union Light, Heat & Power Company, Fargo, North Dakota, was recently re-elected a member of ahe Board of Directors of the Merchants Auxiliary of the North Dakota State Fair Association, and W. P. Chestnut; new Business Manager ofthe Company was elected Secretary-Treasurer of the Auxiliary.

G. W. Milliken, Superintendent of the Arkansas Valley Railway, Light & Power Company at La Junta, Colorado, has been re-elected Secretary of the La Junta Merchants' Association.

J. L. S. Scadding, superintendent of the Fort Madison Electric Company has resigned his position there to go to Keokuk and take charge of the meter department of the Mississippi River Power Company.

Dr. Adams S. McAllister has recently resigned from the editorship of the "Electrical World." F. M. Feiker has been appointed his successor.

Mr. W. P. Cochran, formerly branch manager of the Westinghouse Electric & Mfg. Co. of Baltimore, has been appointed assistant district manager of the Philadelphia district including Baltimore, and will make his headquarters in the former city. Mr. W. H. Jones, assistant to manager, will have charge of the Baltimore branch office.

H. A. Stevenson has resigned his position as assistant electrical engineer for the Underwriters' Laboratories and is now connected with the Starrett Electric Company of Chicago, who manufacture electrical distributing apparatus. He will act in the capacity of sales engineer. Mr. Stevenson is a Jovian and has previously been connected with the electrical department of the Columbus Trades School.

C. D. Wheeler, with the Fort Wayne Electric Works for the past six years, is now connected with Santo Manufacturing Co. of Philadelphia, Pa., in the capacity of alvertising and assistant sales manager. This company manufactures vacuum cleaners of the stationary, portable and sweeper types.

C. A. Yarrington has recently assumed charge of the South Boston Electric Light and Power Company at South Boston, Virginia.

R. F. Pack, General Manager of the Minneapolis General Electric Company, was elected a member of the Executive Committee of the N. E. L. A. at the recent convention at San Francisco.

Due to the increased business of the Detroit Fuse Manufacturing Company, a new three-story concrete and steel plant is being erected at an estimated cost of $60,000.00. Bryson D. Horton is president of the company.

The contract for fans for the new government post office building has been placed with S. J. Stewart, a local contractor covering over 90 direct current, 110 volts, Robbins & Myers fans

Lighting

A Practical Review of the latest developments in domestic, commercial and industrial illumination.

New Street Lighting---Fixtures---Show Windows and White Way Lighting

Some New Street Lighting Fixtures

WITH the development of the type "C" or nitrogen lamps for high candle power, specially designed fixtures are required in order to successfully utilize these lamps for the severe conditions of street lighting service. The life of the lamp and the efficiency of the complete unit are vitally affected by the globe shape, ventilation and weatherproof qualities of the fixture. Inasmuch as the lamp renewal cost per year for each fixture greatly exceeds the first cost of the complete fixture, it is self evident that any construction increasing the life of lamp without lowering the efficiency of the complete unit is of prime importance, and that no make shift device or rebuilt arc lamp should from an economical standpoint be considered for installation with these comparatively expensive lamps.

FIG. 1

Of first importance in the design of any fixture for this service is the ventilation given to the lamp as the heat radiated from lamps of this conception is comparatively intense. Without ample ventilation, the life of the lamp will be very seriously curtailed. Such units should also be weatherproof and at the same time allow for the proper screening of all openings to exclude insects. The exclusion of insects has always been an important requirement in street lighting fixtures but one that has been infrequently fulfilled. As the fixtures are hung in comparatively inaccessible places the frequency of necessary visits should be cut down as much as possible. The high operating temperature of the gas-filled lamp necessitates its careful protection from rain and snow. Consequently, the ventilation must be so arranged that the lamp is not in danger from this standpoint.

The appearance of a street lighting unit is always of importance, inasmuch as it occupies perhaps the most conspicuous position of any piece of electrical apparatus. Such unit should be of symmetrical appearance, both when equipped with reflector and when used without the reflector. A 20-inch reflector of the concentric type gives the fixture the most finished appearance. Fig. 1 shows this type of fixture without the reflector, whereas Fig. 2 shows the complete unit as made by the Westinghouse Electric and Manufacturing Co. The globe is of acorn shape, designed to utilize the light to the best efficiency. A diffusing globe is recommended on account of the high intrinsic brilliancy of the lamp, and because of its suitability for good street lighting requiring minimum glare. The fixture is specially constructed with a view to maximum durability and accessibility. The case is of solid copper, finished in black enamel. The leading-out wires are bought to binding posts of neat, convenient and durable construction, as worked out in the best

FIG. 2

design of arc lamps. The globe is hinged at one side, and latched at the other by means of a corrugated band of copper. This readily enables the replacement of lamps

with but one hand. A specially designed skeleton socket has been adopted as standard for this fixture.

This fixture is primarily designed for use with the high current lamp, and is equipped with a core type auto transformer to enable their use on existing 6.6 and 7.5 ampere constant current A. C. circuits. The 15 and 20

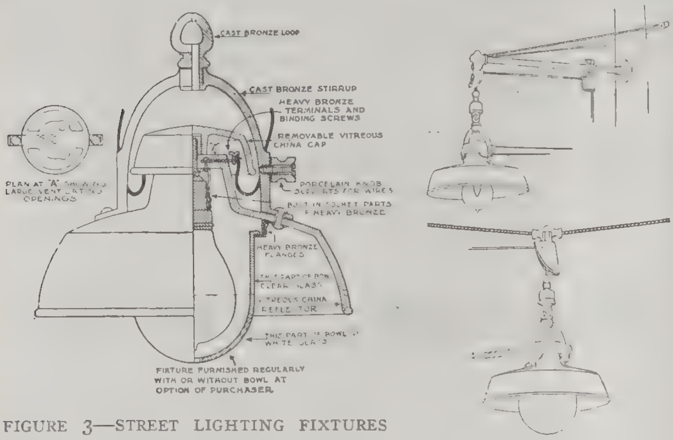


FIGURE 3—STREET LIGHTING FIXTURES

ampere nitrogen lamp has a very much higher efficiency than the lower current 6.6 and 7.5 ampere lamp. Even considering the losses in the auto transformer, the energy saving at 1 cent per kw-hr. on a 4,000 hour per year schedule is sufficient to cause a saving equivalent to the additional first cost of the auto transformer within 18 months. At the same time, the use of the auto transformer eliminates the necessity for a film cutout socket, inasmuch as the open circuit voltage of the secondary of the auto transformer amounts to only two or three times the lamp voltage, and the auto transformer is not injured by continuous operation on an open circuit.

The efficiency of the core type transformer is inherently higher than other types because of its compactness and shortness of the iron circuit. Also, because of this construction, the power factor is materially better, enabling the constant current regulator, on which these fixtures should always be operated, to carry considerably more load than if the auto transformer had a power factor even one or two per cent. lower. The insulation of this auto transformer is very important because of the temperature under which it must operate. The winding is insulated from the coils by means of micarta.

Another form of outdoor lighting fixture as recently produced by the Luminous Unit Co. is shown in Fig. 3. This is made in two forms, one for suspension from brackets, mast arms, cross spans, stems, etc., the other for mounting on ornamental or plain posts. Either of the types is supplied with a partially clear and partially diffusing glass enclosing bowl which encloses the lamp, affording optical protection, as well as mechanical protection to the lamp. This bowl is supplied as optional equipment, the distribution characteristics being approximately the same in either case. Exposed or concealed wiring may be used with either type of fixture as duct space is provided in the supporting structure as well as arrangements for mounting insulators.

The reflector and cap of this unit are of vitreous china of sufficient weight to insure them against breakage by accidental or intentional blows which might be inflicted. All metal parts used in the construction of this fixture are of pure copper or bronze of heavy gauge, sheet metal or cast. This combination is impervious to the elements and freedom from corrosion is thus insured.

The fixtures are furnished for either multiple or series circuits. When used on series circuits it is only necessary to remove the burned out lamp for renewal of the film cut out, as no part of socket or receptacle requires removal as is normally the case with series units.

This facilitates lamp renewals in case of burn-outs. The only change necessary for adaptation from multiple to series circuits is to change the center contact and provide each unit with a series adapter which fits on the base of the lamp, therefore, existing multiple systems may be converted at any time to a series at a very low cost so far as the units are concerned.

The New Lamp for Sign Lighting

The Edison Lamp Works of the General Electric Company have just recently developed a new sign lamp of 7½ watts and 105 to 125 volts rating. This is the lowest wattage Mazda sign lamp manufactured for operation on such circuits. It gives five candlepower, and operates at a consumption of 1½ watts per candle with an average total life of 2,000 hours.

This new sign lamp is inteneded to replace the 10 watt carbon sign lamps; particularly those which did not give way to the earlier 10 watt Mazda sign lamp. Some of the smaller signs continued using the carbon lamp instead of this ten watt lamp as the latter furnished a little too much light to gt the best effect. The new 7½ watt sign lamp will remedy this, as it gives the neecessary candle power to obtain satisfactory results. The 7½ watt lamp has the following advantages over the ten watt carbon lamp:

A higher efficiency, lower wattage and more attractive light. In short, more satisfactory in every way.. It has practically the same construction as a ten watt Mazda sign lamp.

The Kelly-Springfield sign, which is shown in Fig. 1 represents an installation of 2,500 of the new 7½ watt sign lamps on a 110 volt circuit.

APPLICATION OF THE NEW SIGN LAMPS

Post Lighting Up-to-Date

*By Dean K. Chadbourn**

How many cities and towns in your territory have not installed ornamental posts? Every one of these is a live prospect for profitable business. The introduction of nitrogen type "C" lamps has revolutionized the methods of ornamental street lighting, making it possible for every hamlet in the country to have a lighting system that would be a credit even to the largest and most progressive cities. The proper form of lighting system to employ depends on the local conditions that may be under consideration, but when it comes to the question of ornamental posts there are only two conventional designs to choose from.

Ornamental street-lighting practice using incandescent lamps may be divided into the cluster post system and the single light post system. The former is generally operated on multiple circuits of 110 or 220 volts with the lamps so connected that the top lights burn all night while the pendant clusters are turned off before midnight. Single light posts are invariably operated on series systems, sometimes on twin series circuits with lamps connected for turning off alternate lights at midnight. For arc lamp circuits the single-arm post is more commonly used.

In selecting the type of post, the size and general appearance of the city and the width of streets to be lighted must receive due consideration. Such design should harmonize with the general surroundings, and the system as a whole should be decorative by day as well as by night and afford adequate illumination. The illustrations in Figs. 1 and 2 show two typical designs of ornamental standards.

The single light post for general purposes seems to be in favor, its low initial cost and the cost of maintenance being largely responsible for its adoption. They are more artistic than cluster posts, both singly and in perspective, presenting a more dignified appearance. Single light posts are not out of proportion as regards the view along the street especially in places where there are trolley or other poles and also signs which tend to give the thoroughfare a crowded appearance.

On the other hand, the value of display effects may be an important point in favor of cluster lights. When the merchants of a town are inclined towards an ornamental lighting system, their interest for backing such "White-Way" projects will usually be traced to personal reasons. In such cases the cluster posts have an inherent value not to be found in any other standard, especially as they make the lighted portion of a street appear longer than it really is.

This accounts to a great extent for the use of cluster standards in many a mercantile district, while the single light post is almost invariably used for parks, boulevards and the residential districts. In the business section of large cities, however, the luminous arc still holds its own. Then the type of post best suited for a given case is really governed by the conditions of that particular instance.

What these various types of posts represent in the form of monetary expenditure is shown by the figures in Table I. These values are averages based on actual costs gained through experience in installing such systems. The figures cover the use of nitrogen lamps, except for the luminous arc named, and are so stated that the costs may be determined for different size units, space at various distances. The photographs appended

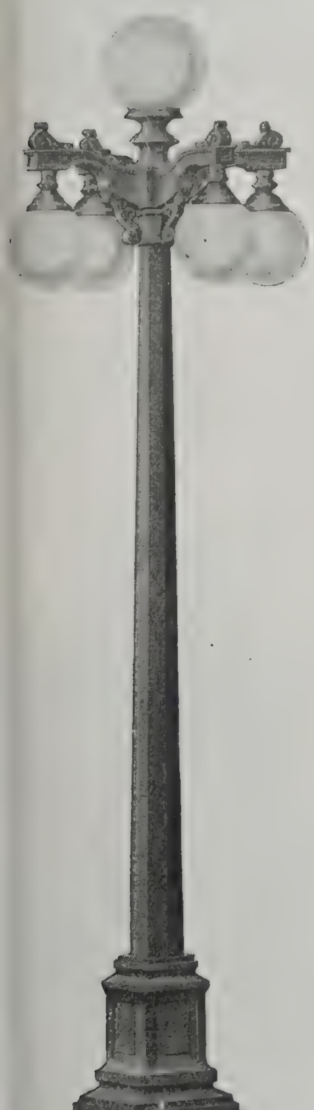


FIG. 1—FIVE LIGHT COMMONWEALTH POST

FIG. 2 — PARK VIEW POST

FIG. 3—MERIDIEN ST., INDIANAPOLIS

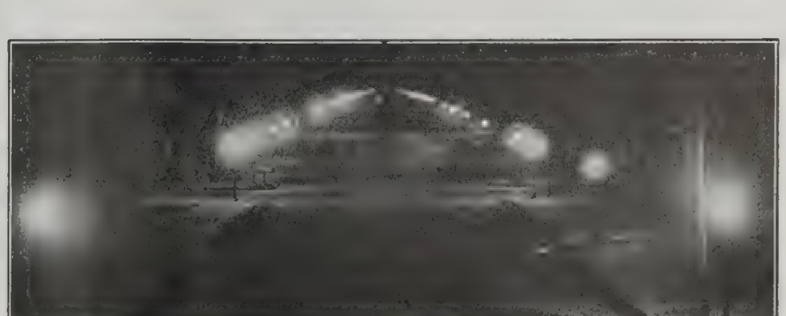


FIG. 4—FIVE LIGHT CLUSTER POSTS, MICHIGAN CITY

*New York Manager George Cutter Co.

hereto show several recent installations of ornamental street lighting equipments. In Fig. 3 is shown a night view of 5-light clusters illuminating the principal business street in Michigan City, Indiana. The standards used are of the Commonwealth pattern as previously illustrated.

In a more recent system, 2,200 single light posts of the Park View pattern, as previously illustrated, were installed. Out of this number 700 posts with 100 watt nitrogen lamps are lighting Meridian St., the principal residential street in the City of Indianapolis. The remaining number are distributed throughout

FIG. 5—FLOWING ARC ON POLE

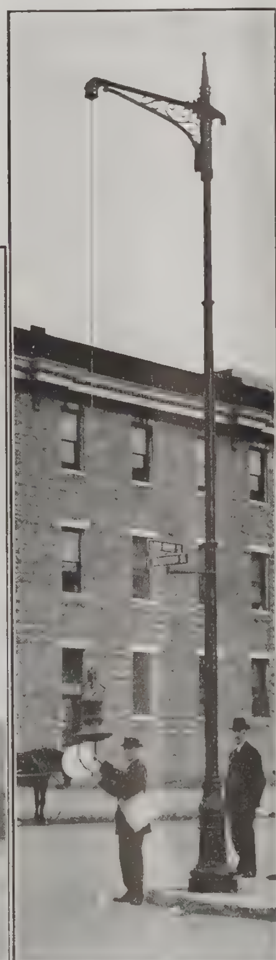


FIG. 6—USE OF CUT OUT PULLEY

the parks and boulevards. In Fig. 4 is given a view of Meridian street, with the lights on.

The business section of Indianapolis is lighted by Westinghouse luminous arcs, hung on ornamental poles, as shown in Fig. 5. These poles are equipped with a safety feature in the form of automatic cut-out pulleys so that the lamps may be trimmed or cleaned by a man standing on the ground level. In Fig. 6 is a photograph showing the advantages of the cut-out pulley with respect to the safety in which the trimmer is seen at work. All the above named posts, poles and cut-out pulleys were furnished by the George Cutter Co., of South Bend, Indiana.

Table I—Average Costs of Post Installations

System	Single Light Posts (Series Circuits)					Cluster Lighting (Multiple Circuits)			
Distance Between Posts, in feet	150	65	85	115	150	100	85	75	65
Total Cost per Post Installed.	$185	$50	$65	$82	$105	$145	$115	$100	$85

Figuring the Drops in Voltage

J. WITMORE

A safe and concise formula for simply finding the volts drop in a circuit, may be expressed as follows:

$$\text{Volts Drops} = \frac{22 \times D \times A}{C.\ M.}$$

in which 22 is a constant; D represents the one-way distance of the circuit, in feet, and A is the current being transmitted, in amperes, and C. M. stands for the circular mils correspnding to the size of wire used.

In the problem asking what the drop in voltage would be in 90 feet of number 6 stranded wire, carrying 45 amperes D. C., it is not clearly stated whether this means 90 feet of wire or a circuit 45 feet long. In electric practice the circuit is measured only one way from the source of supply to the load, so that if 90 feet designated the circuit, this would mean that there is 180 feet of wire.

Thus for a 45 foot circuit we have:

$$\text{Volts drap} = \frac{22 \times 45 \times 45}{26250} = 1.697 \text{ volts}$$

But for a 90 foot circuit, the loss in voltage would be twice that or approximately 3.4 volts. The figure 26250 is the circular mils in a number 6 wire.

Lighting a Shoe Store

THE illustration in Fig. 1 is that of a semi-indirect lighting system, installed in one of the most modern shoe-shops of the South. The store has an unusually high ceiling, 26 feet, lending itself admirably to this type of lighting. It is white, unadorned and supported by generous pillars which add to the general appearance of the interior. The illumination is furnished by seven 23 inch Brascolite units with 400 watt, nitrogen filled lamps. The results are a total absence of glare and shadows, the illumination being so evenly distributed that there are no dark corners or irregular splotches of light on walls, ceiling or floor.

This installation was planned by the Western Electric Company and installed by C. A. Nash and Company, of Norfolk.

FIG. 1—INDIRECT LIGHTING IN A SHOE STORE

The Luminous Arc for White-Way Lighting

ONE of the first installations of the new type of pendant luminous arc lamps equipped with prismatic glass refractors, was recently made at Charleston, W. Va. The system of lighting in this city may be divided into three classes: "White Way," or ornamental lighting, in the business section; intermediate lighting in the residential section, and suburban lighting.

THE LUMINOUS ARC IN THE RESIDENTIAL DISTRICT

In the White Way section are installed sixty-two General Electric 4 amp., ornamental luminous arc lamps, using high efficiency electrodes and equipped with fine texture Alba globes. The lamps are mounted on ornamental brackets manufactured by the Electric Railway Equipment Company. The brackets are supported on steel trolley poles with overhead line construction. The poles are spaced approximately 120 ft. apart on each side of the street and are staggered. The elevation of the lamps is 16 1-2 ft. from the curb to the arc.

With this spacing, a well-diffused and brilliant daylight effect is produced, with an entire absence of shadows; and on account of the peculiar shape of the globe, considerable light is projected upward, which illuminates the front of the buildings from the pavement to the cornice. This soft and well-diffused distribution of bright light is particularly effective and practical for business sections.

In the residential sections and throughout the greater part of the city, pendant luminous arc lamps with refractors and operating at 4 amp. are employed. These are hung from 22 to 25 ft. above the street, at street intersections, which spaces the lamps from 300 to 400 ft. apart. The refractor type of lamp, on account of its extensive distribution of light, is especially adapted to such spacing, producing an even illumination on the street surface. Both the center span and mast arm suspension are used, in conformity with the physical requirements of different localities. These are illustrated in Figs. 1 and 2 respectively.

In the remaining outlying portions of the city and in suburban sections where the use of large units is not warranted, low wattage series incandescent lamps are employed, mounted on brackets and equipped with radial wave reflectors. The entire system is operated from General Electric fifty-light, double tube, series rectifier sets.

THE LUMINOUS ARC IN THE BUSINESS DISTRICT

THE LUMINOUS ARC IN CENTER SPAN

How to Light a Show Window

A. D. Curtis

A NEW era in store window lighting has been brought about by the invention of the gas-filled "C" nitrogen lamp. As is the case with most new things, the nitrogen lamp is being used by many people who have no knowledge of its construction and very little concerning its application.

Many of the merchants who are lighting, or attempting to light, their store windows with the form "C" lamps use equipment that was designed for a wholly different style of incandescent lamp. It is important that the folly of such attempts should be pointed out. Satisfactory results cannot be secured from these or any lamps unless they are used with proper reflectors.

Merchants who use the gas-filled lamps in old reflectors intended for the vacuum tungsten lamps, are disappointed because there is not the great increase in illumination they expect. Naturally they condemn the lamp whereas it is very efficient if the intense light which it produces is properly directed.

As these new gas-filled lamps, particularly the 100 watt, will undoubtedly be used to a very considerable extent in window lighting, the following facts concerning their construction and the accompanying suggestions as to their correct use are set forth.

These lamps differ from the vacuum lamps formerly used, in that the filament, or light source, is located close to the lower end or tip of the lamp and is much reduced in size. Owing to this concentration of the light source, and its location, it is necessary, in order to protect the eye from its intense glare and to throw the light down into the window, that the reflector must have a particular shape. Not only must the shape of the reflector be correct, but it is necessary to have spiral corrugations. Furthermore, these corrugations must be rather small. The filament of the lamp, being so concentrated, straight corrugations result in what is called striations or streaks of light and shadow. The small spiral corrugations break up the intense light rays, and if the reflector is of correct shape, the light is thrown straight down into the window and sufficiently high into the background to cover the window trim evenly.

This nitrogen lamp of 100 watt size, which seems to be the most practical for window lighting, produces 125 C.P. as against 105 of the 100 watt vacuum lamp previously used. As nitrogen lamps generate extraordinary heat, it is necessary that the reflectors have a special backing which will withstand high temperature indefinitely.

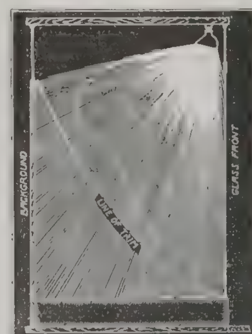
The correctly shaped reflector secures efficient results, preventing the light rays from going to the top or side of the window or out on the background.

Figs. 1 and 2 show two types of window searchlights designed for use with gas-filled lamps. Their shape, corrugation and high temperature backing conform to the requirements which have just been described. The "Jove" reflector is suitable for windows which are from one to one and one-half times as high as they are deep, the depth being measured from the front glass to the background, and the "Jupiter" reflector, with its increased concentrating power, is designed for windows with a height approximately twice as great as the depth.

Too much emphasis cannot be placed upon the fact that for correct window illumination the light filament of the lamp should be contained in reflectors that prevent the passerby or persons in the store seeing the lighting source. This is now a well-recognized principle in illumination, but from observation it would seem that many merchants do not realize its importance.

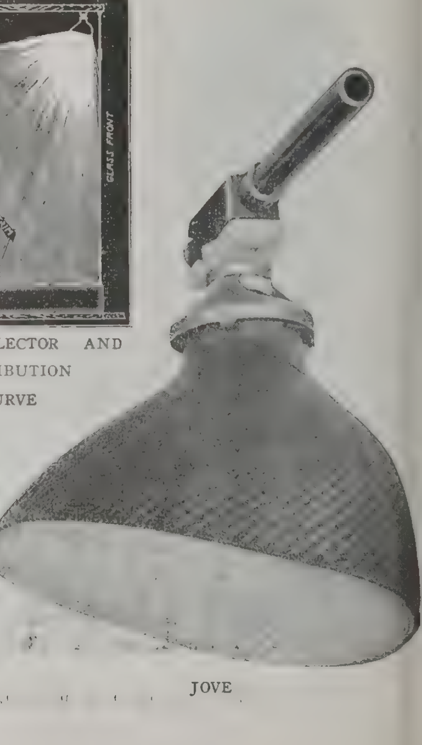
Figs. 3 and 4 show the respective light distribution, or curve of direction in which the main flux of light is thrown into a window by the combined use of the Jove and Jupiter reflectors with 100 watt gas filled lamps. These types of reflectors have been recently produced by the National X-Ray Reflector Co.

JUPITER REFLECTOR AND DISTRIBUTION CURVE



JOVE REFLECTOR AND DISTRIBUTION CURVE


JUPITER


JOVE

Installation, Operation Power Application

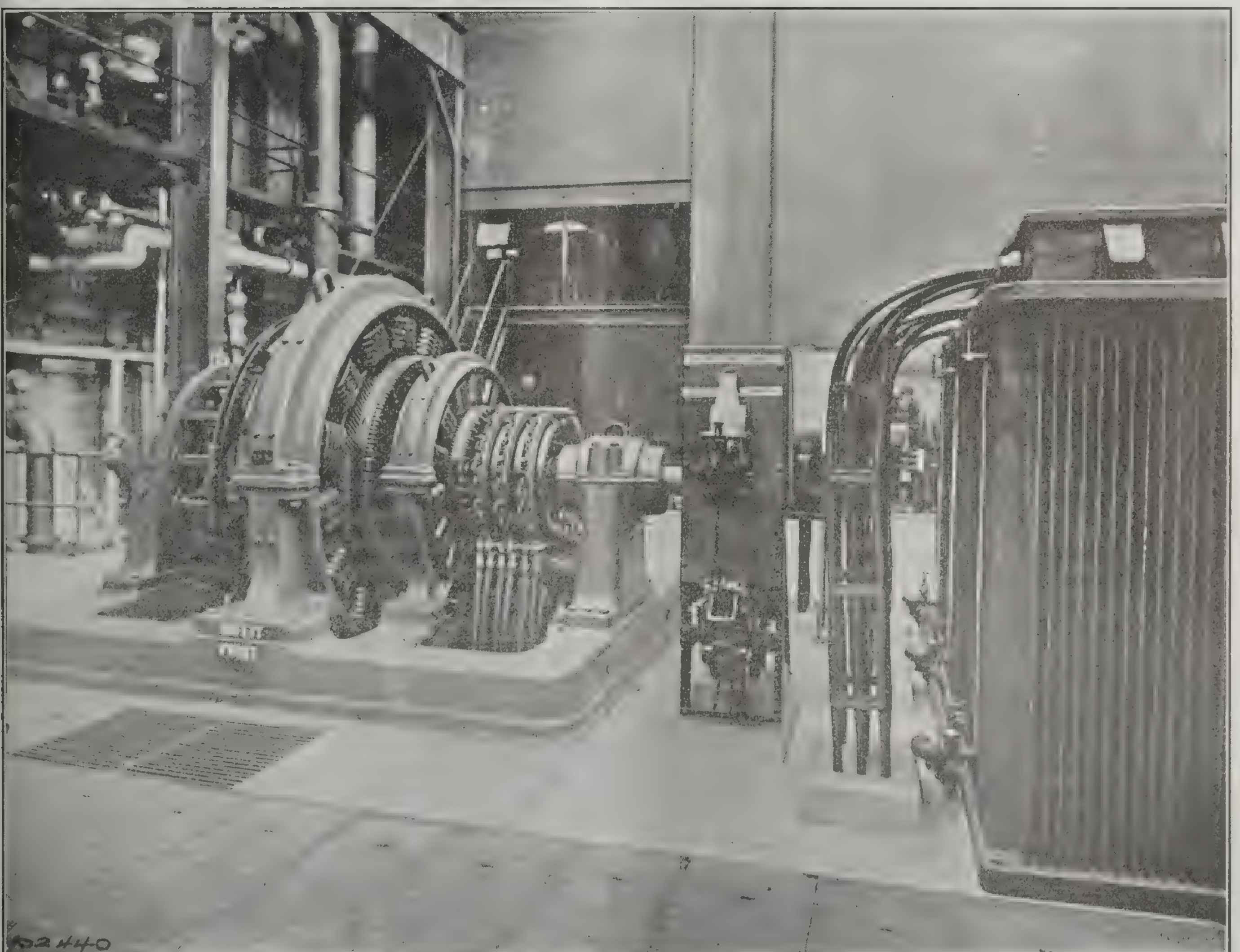
A Record of Successful Practice and Actual Experiences of Practical Men.

Why a Rotary Converter Was Selected

AFTER the Ohio flood in 1913, the Dayton Power and Light Company found it advisable to increase the capacity for supplying its direct-current three-wire system so as to insure its many customers using direct current, of being supplied with continuous service. The question of whether it would be a motor-generator set, or a rotary converter for transforming the alternating to direct current, was very carefully considered by the company's engineers, and the latter was finally decided upon, for the following reasons:

1.—Smaller conversion losses.

2.—Less current required for starting.



SYNCHRONOUS BOOSTER ROTARY CONVERTER OF THE DAYTON POWER & LIGHT CO.

3.—Lighter weight.
4.—Less floor space.

The illustration in Fig. 1 shows the new equipment which was purchased from the Westinghouse Electric & Manufacturing Company, and consists of one (1) 1,000 KW, 4,000 ampere, 250 volt, voltage range—213 to 288 volts, 6 phase, 60 cycle, Synchronous Booster Rotary Converter, operated from three (3) Westinghouse 365-kva. single-phase transformers (primary voltage—13,200—6,600—2,200—secondary voltage that necessary for 250 volt rotary operation).

At the present time, this unit is operated from a 2,200 volt sub-station bus, but the other voltages were provided to enable it to be operated at a higher voltage, which will be obtained later when other improvements that are now contemplated will be completed.

This equipment is arranged for both alternating and direct-current starting, and requires less power for either method of starting than a synchronous motor-generator set of equal capacity.

The operators all show a preference for the booster converter, as it has proved itself a very easy machine to handle, consequently it is in operation a good portion of the time. The D.C. voltage can be varied at will from the switchboard by means of a small booster rheostat.

This unit has been in operation for about seventeen months, and is loaded daily up to approximately 4,400 amperes, which is a 10 per cent. overload at the normal voltage. During one extreme condition this machine delivered 5,500 amperes at 230 volts, for almost fifteen minutes. This was due to a voltage disturbance, which caused the motor-generator, with which the rotary was operating in parallel, to fall out of step and disconnect itself from the line. During December, 1914, the converter operated normally eighteen hours a day and the average load factor for the month, taken from the station operating log, proved to be 79 per cent., ranging from a minimum of 70 per cent. to a maximum of 89 per cent. daily. This booster converter has met the exacting requirements of the Dayton central station operation in a satisfactory manner.

There seems to be no logical reason for retaining a prejudice against sixty-cycle converters, since the machines built to-day have eliminated the objectionable points that were characteristic of those of earlier design. This is certainly borne out by the operating results obtained in this installation and that of various companies using modern sixty cycle synchronous converters.

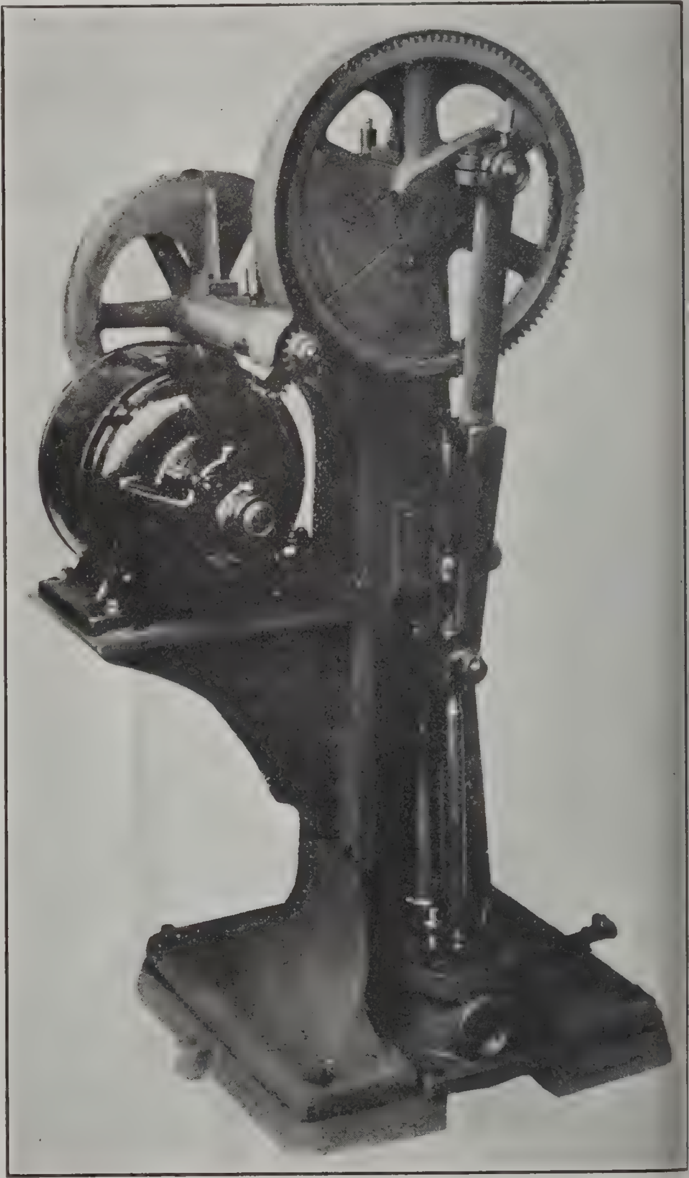
Using a Motor for Water Pumping

Where the city water is expensive, and an abundant supply of good water essential, some local supply must be resorted to. In some localities the water does not lie near the surface and wells must be sunk, requiring the use of a deep well pump. The Hill pump is one type of electric-driven deep well pump now on the market and is illustrated in Fig. 1.

When operating 2-inch, 2½-inch or 3-inch single acting cylinders it will raise water to total heights of 180, 125 and 90 feet respectively. It can be used with any of the common forms of well cylinders.

The machine is wholly self-contained and is very compact, with its parts sturdily constructed and of the best materials. All gears are machine cut and, as the illustration shows, are well shielded.

This head can be used in connection with open or elevated tank systems or with closed tank pneumatic pressure systems. When used with the pneumatic pressure system, an air pump furnishes air to the tank through the water discharge. Water is raised on the upstroke while air is forced in on the downstroke, thus equalizing the pressure.



MOTOR-DRIVEN DEEP WELL PUMP

The motors used on these heads, one of which is shown in the illustration are ¾ h. p. Westinghouse Electric single phase type AR. The motor is mounted rigidly on an extension of the pump support and is capable of starting the pump motor full load.

The whole outfit s very compact, quiet in operation and extremely economical. It can be operated twenty-four houre every day and requires practically no attention.

The Outdoor Sub-Station for Industrial Service

The increasing use of high capacity outdoor sub-station equipment is well illustrated by the installation shown in Fig. 1, which supplies industrial loads from a 33,000 volt 3-phase 60 cycle transmission feeder.

The transformers are of 500 KVA capacity each, stepping down from 33,000 to 2,300 volts, the secondary lines being run in the usual manner to various consumers. A spare transformer forms a permanent part of the installation, and can be quickly connected in case of failure.

The high tension control equipment consists of a standard 3-pole air break switch, three choke coils and three 15-ampere chemical fuses. The lightning arrester installation is equipped with three single pole underhung disconnects, by means of which the arresters can be cut out of service.

The secondary circuits are controlled by oil switches, mounted in the distribution house, from which the industrial lines are carried. By means of a permanently grounded operating handle the 33,000-volt air break switch can be controlled, the fuses being easily reached from the platform, after the main switch is opened.

The air break switch, choke coils, fuses and disconnects are of standard form, and manufactured by the Delta-Star Electric Company, the electrolytic arresters being of General Electric manufacture and the transformers of Westinghouse type. That large central stations are now extensively using outdoor equipment for important industrial loads of this class, is conclusive evidence that the outdoor sub-station has demonstrated its reliability.

In connection with such sub-stations another form of outdoor switching and metering equipment to control and measure their output satisfactorily may also be used. Primarily intended for outdoor mounting, the exposed location demands a housing that is waterproof and at the same time affords protection to the apparatus contained therein against unauthorized persons.

To meet this demand, the Westinghouse Electric and Mfg. Company has developed two lines of outdoor switch houses, one for pole, wall or tower mounting, and the other for setting on the ground. In Fig. 2 are given the dimensions of the pole type of switch house.

The housing of both types consists of sheet steel, built up on structural steel framework with a large door in front to permit ready access to the apparatus. Attention is called to the fact that all the apparatus contained within the switch house is accessable from the front, and it is not necessary to remove the back of the house in order to gain access to any of the apparatus or wiring.

The switching equipment consists of a full-automatic self-contained, series-tripping, oil circuit-breaker mounted directly

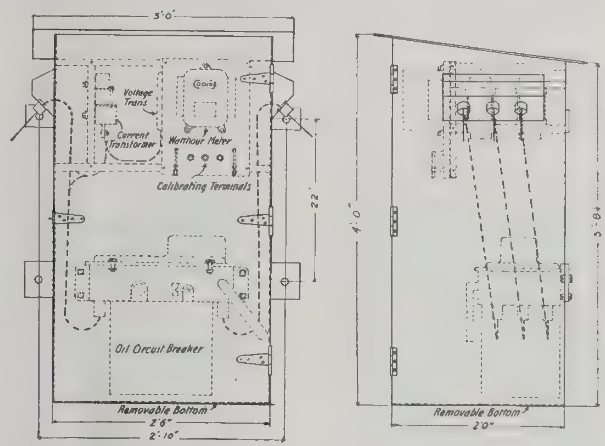


FIG. 2—DIAGRAM OF OUTDOOR SWITCH HOUSE

on the steel framework of the house. The metering equipment consists of a standard house-type polyphase watthour meter together with the necessary current and voltage transformers, fuse blocks and fuses. The meter is mounted on a small slate panel on which are also placed the necessary current and voltage terminals provided for the connection of the operating company's testing and calibrating meters.

The pole-mounting feature of the switch house shown in Fig.

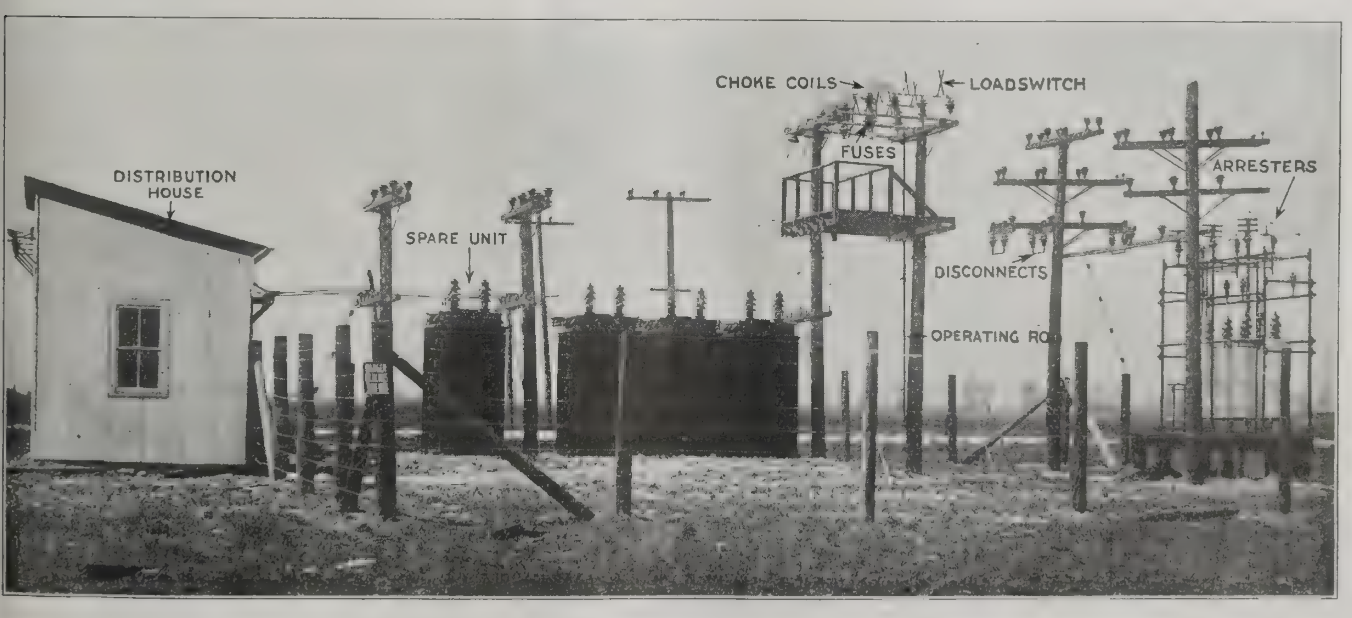


FIG. 1—COMPLETE OUTDOOR SUBSTATION

2 eliminates the necessity of removing the back and it is possible to install this house on hanger irons for pole mounting the same as a transformer; the approximate weight being about 600 pounds. It may also be mounted on steel towers, which method is being rapidly adopted by a great number of central stations. The switch house is also adapted for mounting on a wall in proximity to the apparatus controlled.

Saving Time with an Electrical Hammer

IN THIS electric age there is hardly a location where electric current is not available, and instead of making his power as he formerly did, the building contractor buys it and applies it through motors at the most advantageous points.

One of the special applications of electricity comes in the use of electric hammers, replacing the man with the sledge or hammer and star drill and the air compressor with its piping and hose. Figs. 1 and 2 show the old and new ways, respectively. A man with an electric hammer

THE OLD, EXPENSIVE, LABORIOUS WAY

THE NEW, ECONOMICAL, ELECTRICAL WAY

may be expected to do about as much work as six men working by hand. This is easily explained by the fact that a man with a hammer strikes from 50 to 80 blows a minute while the electric tools strike from 1,400 to 4,000.

The line of Western Electric hammers now on the market, can be operated at a power cost that is practically negligible, ranging from 2c to 5c an hour and depending upon the size of hammer used. The equipment investment is small, only the cost of the tool having to be considered.

To use one of these hammers it is only necessary to connect the tool to the nearest lighting outlet or wires. The low first cost of the equipment combined with the ease of operation, makes its use advantageous and practicable, not only where pneumatic tools have heretofore been used but on a large class of work whose magnitude did not make it economical to install an air outfit.

These electric hammers have long since passed the experimental stage and are being used successfully by companies installing switchboards, pneumatic tube systems, piping, railings, sprinkler systems, fire escapes, fire doors, etc. One general contractor tells of the great saving through the use of these tools in taking out the mortar between bricks for repointing another of using them in breaking up old engine bed foundations and sidewalks. Paint mills use them for dressing mill stones, ice plants and central stations for chipping scale off condenser tubes. In fact, wherever a rapid succession of blows makes for saving, these electric hammers are being used successfully.

How That Pertinent Question Was Answered

In trying to sell your electrical goods to the average householder the first question you are up against is "How much will it cost to operate?" The Twin State & Gas Elec. Co., of Dover, N. H., have installed in their showroom a device that will answer this question in a way that instantly attracts attention. They have had a 7-inch switchboard type single-phase indicating wattmeter mounted on a small slate panel above a lamp socket, and both connected to their lines. The wattmeter has a black dial with white figures and pointer to make the readings stand out clearly, and has been calibrated in "Cents per Hour" instead of standard watts. The scale is based on 15 cents per KWH., the rate in this case. Any heating device can be attached to this circuit, and the prospective customer gets an ocular demonstration of the "juice" it takes. The panel and the mete, were supplied by the Westinghouse Electric & Mfg. Company.

New Pittsburgh Headlight Mounted on Bracket For Motor Truck or Trouble Wagon Use

The new Pittsburgh Searchlight employs a powerful focusing lense in connection with an 8-inch parabolic reflector, which produces a beam of light with ample thrust for automobiles and motor boat use for a current consumption of only one ampere (thus making the ordinary dry cell battery an economical source of current supply).

The bulb is a 6 volt Mazda and the lamp can therefore be used with any 6 volt lighting system, as well as with ordinary dry cells.

For automobile use it may be mounted on the door or wind shield. It not only serves as a searchlight for reading sign boards, turning and backing, but answers the purpose also of an auxiliary headlight for use in emergency cases. It gives the gas lighted car the use of electric light whenever needed.

For motorcycles it affords a satisfactory headlight that can be attached to any machine without the expense of installing a lighting system. Similarly with the motor boat and with the delivery truck.

Its utility as a searchlight for trouble wagons will be apparent to every central station operator. This outfit consists of two brackets, one for mounting on the dash board and another for use on the ground or wherever needed. The lamp gives ample light from its position on the ground or motor trucks, for the use of a workman at the top of the tallest pole.

The lamp is manufactured by the Pittsburgh Electric Specialties, Company, Pittsburgh, Pa.

Cleaning Fields of Turbo-Generator

For the purpose of cleaning a turbo-generator, it is unnecessary to go to the expense of removing the fields. By simply removing the end bells and using compressed air at a pressure of approximately 50 pounds per square inch, nearly all dust and foreign matter may be satisfactorily blown out. Unless the generator is subject to considerable dust, the practise of cleaning this with compressed air every two months will be found entirely sufficient. However, if the unit is so located as to be subject to excessive quantities of dust, or if the air supply contains a considerable amount of impurities then an air washing equipment placed in the air intake would be an economic advantage.—*Ernest S. Ford.*

Problems in Electric Practice

Questions and Answers and Practical Discussions of Trade Affairs

How to Plan Pole Layouts

By C. O. Roddy

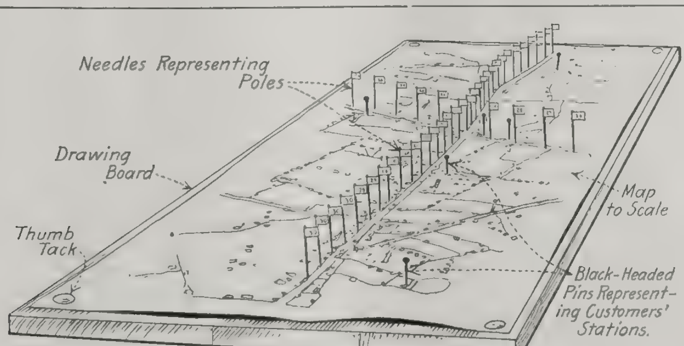
THERE is a method of making pole line layouts using pins or tacks to represent poles, that is capable of being a medium for saving much time and expense, when correctly applied. The essential idea of the method is that, after the route of a pole line has been mapped out, pins or needles or tacks are set on the plan at the points where poles are to be erected. Pins of different heights or with heads of various colors are used to designate poles of the several heights or those carrying different equipment, whereas in the layout, Fig. 1, needles with celluloid flags distinguish the various features. The map on which pins, needles, or tacks are inserted, should be drawn to scale, so that the distance between them will show relative spacings of the line. After the pins have been placed, bills of material, labor and haulage estimates can be compiled very readily. The graphic representation of the line thus completed gives one a better view of the problem than might be gained from the usual plat laid out on a sheet of drawing paper.

The following illustrates the application of this method, when using tacks, to simply designate poles. The first move is to secure a map of the territory, drawn to scale so that the actual distance between tacks can be computed proportionately. The map is fastened to a drawing board with thumb tacks. Red-headed upholsterer's tacks, which may be procured at stationery or hardware store, are to be used for 30 ft. poles.

A red-headed tack is driven into the drawing board for every 30 ft. pole along the route of the line. Where there is an irregularity in the topography of the country that necessitates the use of poles longer or shorter than 30 ft., tacks having heads of other colors can be inserted to represent these poles. For example, if the line passes over a rise of ground on the top of which a 25 ft. pole would be desirable, a white-headed tack can be used to designate this. If the line passes over a hollow where a 35 ft. pole should be set, a yellow-headed tack may be inserted at this point. An ordinary carpet tack or a brad can be used to indicate a guy stub, and one of these should be driven into the board at all points where guying is necessary. In the case of a telephone line, the subscribers' stations can be represented by large black-headed upholsterer's tacks, or if it is a current distributing system, the same may be used to denote lighting customers or motor loads.

After the line has been laid out with the tacks, on the drawing board, the bill of material and the cost estimate can be compiled therefrom. The first step is to list the number of loads of poles. If more than one length of pole is required for the line, a separate list should be made for each load of poles so that the poles can be piled on the truck in such order that when any pole-hole is reached, the pole of proper length for that hole can be taken from the top of the pile on the truck. Where the system of loading poles is in accordance with the route of the tack-pole layout, as above, one man can drive the truck and also unload the poles. With random piling it is often necessary to dig down into the center of the load for a pole of a certain height for some particular point, thus two men must accompany the load, thereby increasing the labor cost.

One of the most valuable applications of the pin-plot



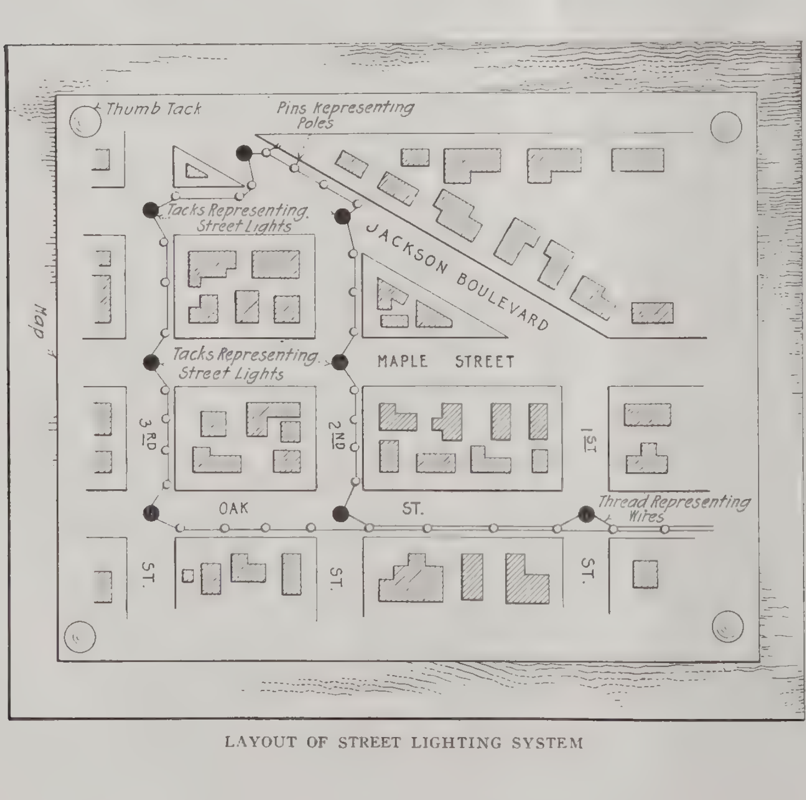
USING NEEDLES FOR POLE LINE LAYOUT

method is its use for the economical planning of series street-lighting circuits. With these circuits it is frequently the case that only one of the wires of the circuit will traverse the section of a community, as shown in Fig. 2, but there is more than one arrangement of wires and poles that could be installed to serve street lights at designated locations. It has been the writer's experience that the most effective method of finding the most economical lay-out for a given condition is to make a plot as above described, using pins for poles. Large headed tacks can be used to represent street lights and then a linen thread can be strung around the pins and tacks to represent the line wire. After making several trial lay-outs with the thread, pins and tacks, the one of least cost may be readily decided on.

Where a central station representative must appear before a City Council relative to the installation of a series street lighting system in a municipality, he will find that a pin-tack-thread lay-out of the system, as the central station proposes it, will be of great assistance. Where the representative has such a plot beside him, he can easily explain why it is expensive for the central station to serve lights where a long loop from the main portion of the circuit is necessary, and he can also show how expensive it is to move street lights from one corner to another or to scatter them around without any particular regard for system.

Where a company proposes to make a great many of these graphic plots of pole lines, it will be found that it is economical for it to equip itself accordingly. In such a case, strong tacks having small disk-like heads of different colors should be used, as they are particularly well fitted for the representation of poles and the like. These may be purchased from filing-case manufacturers.

Where needles are used, it is a little difficult to insert them in the drawing board, unless some form of driver is used. Small flags as shown in Fig. 1 can be pasted in the eyes of the needles and on these flags can be marked the heights of the poles that they represent. The flags for the needles can be made of celluloid if desired. They can then be placed over the needle heads after the needles have been inserted in the drawing board.



LAYOUT OF STREET LIGHTING SYSTEM

That Question of Trans- former Windings

H. G. Davis

DIFFERENCES in windings of transformers bring man complications in meter work as well as in power work some of which are as follows:

Referring to the diagrams it will be noted that the winding are shown on different cores. In Fig. 1, the instantaneous di rections are such that the effect is the same as if no transforme were in the circuit. In these sketches the magnetism in th core of one winding is inside reverse direction from that i the core of the other winding, so that where both windings o one transformer are alike, i. e., both right hand or both lef hand, the polarities are as shown in Fig. 2. In any transforme

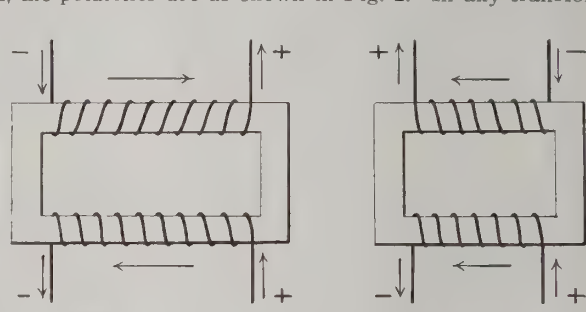


FIG. 1 FIG. 2

TRANSFORMER WINDINGS

where the windings are interlaced the core for primary an secondary is the same. This makes Figs. 1 and 2 misleading for with a common core and like direction of winding as i Fig. 2 the polarities are as shown in Fig. 1. Thus we coul interpret Fig. 2 in two ways—that it is desirable to have bot windings in the same direction on the core or that it is de sirable to have the polarities as shown.

Considering Fig. 2 for polarities only and considering tha the corresponding leads of primary and secondary are positiv and negative as shown, it can be seen that the instantaneous di rection of current for corresponding leads in the two winding is reversed. This means that interposing a trans former, changes the instantaneous direction of th current. If three power transformers were used o a three phase connection, having polarity reversal as shown in Fig. 2 then motor were connected firs to primary and then to secondary, (assuming a to 1 ratio of transformation it would show a re versal of rotation. Furthermore a three phase com bination of 3 single phase transformers of polaritie as in Fig. 1 could not be parallelled with a combina tion of 3 transformers of polarities as in Fig. by any changing of leads from the delta points or b reversal of the three phase leads. The individua leads from the transformer to the delta connection would need reversal. This it ss essential to know in paralleling three phase combinations. All trans formers should be of like polarities or at least th polarities should be known. The polarity of a shown in Fig. 1, irrespective of internal connec tions shows the current in the same directio through the transformer as if no transformer wer interposed. Thus phase rotation on the secondar of any combination would remain the same as th primary for corresponding connections of leads This fact makes this polarity desirable and polari ties as marked on Fig. 1 are to be desired.

Considering the internal winding only and assuming the wind- ıgs on the same core, where the primary and secondary are ·ound in the same direction, the induced voltage in the secon- ary winding is in the opposite direction to the impressed volt- ge of the primary. Thus at one primary terminal the current ould flow out. Then if the windings had the same number f turns and the adjacent ends of primary and secondary were onnected together there would be no voltage between the other :ads of primary and secondary. Under all conditions with one ad of primary and adjacent secondary lead connected together ıe voltage between the other two terminals would be the dif- ·rence in voltage of the two windings. Thus the static potential ress to ground is lessened in this type of winding and the re- uired insulation between primary and secondary is lessened. his makes an enormous difference in power transformers high voltage. For windings on the same core and in opposite rections the difference of potential on one end when a pair of orresponding terminals are connected together is the sum the potential of the two windings. Thus the stresses in the sulation is increased.

Windings in the same direction are preferable when primary ıd secondary are on the same core and the polarity leads ould be brought out to give the polarity shown in Fig. 1. This eans that the adjacent leads of primary and secondary should of the same polarity, both positive or both negative, and for indings on the same core the direction of winding should be e same for both primary and secondary. This would avoid ternal stresses between primary and secondary due to opposite larity and for a non-reversal of polarity the leads could be ought out together from the same ends of coils. In any case e leads should be brought out to give non-reversal of current ıd thus avoid complications in paralleling or in three phase mbinations even though the internal windings are not in ıe same direction on the core.

This question of transformer polarity and stresses due to dif- ·ence in method of winding was discussed at some length by writer during 1913 in a series of articles which appeared in ECTRICAL ENGINEERING, then known as the *Southern Elec- cian.*

Control for a Compound Wound Motor

There is more than one way of wiring for a compound wound tor, varying with conditions. In the diagram of Fig. 1 the ll line starting connections, are such as have been often used cessfully. To change such connection so as to conform with wiring indicated by the dotted line X, which means a line m the coil of the no-voltage release to the last step of the re-

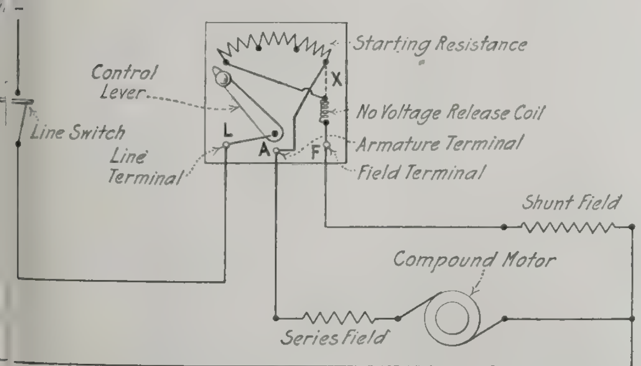


FIG. 1—WIRING FOR MOTOR CONTROL

sistance, in lieu of that shown by the solid line, is not advisable because a full strength field is not gained by the *IR* drop of the starting resistance.

In the diagram of Fig 2 is shown a more desirable form of wiring, since the service connection to the armature circuit starting resistance is eliminated.—*F. G. Flickinger.*

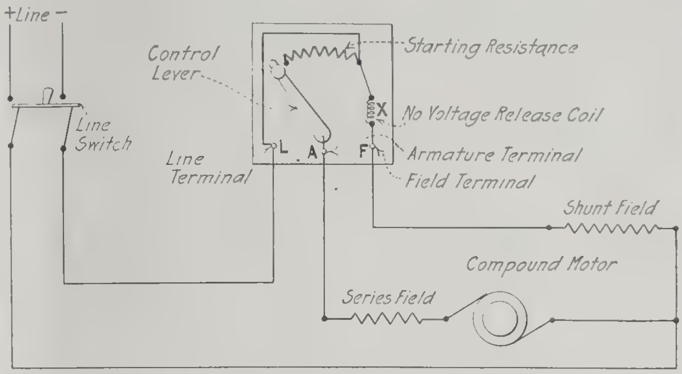


FIG. 2—WIRING FOR MOTOR CONTROL

Another view on this question of proper control wiring is as follows: The connections as shown by the full lines in Fig. 1 are customary for a starting box. When so connected the full voltage of the line is across the field at the time of starting; the current flowing through the field will therefore be at its maximum, which means the strongest field and the minimum starting current through the armature. When the armature is up to full speed and the starting lever is fully over to the right hand side all resistance will be cut out of the armature circuit but will now be in the field circuit. For ordinary practise this is satisfactory because the rheostat is designed for such mode of operation. Of course, with the low-voltage release connected in series with the field, when not designed for such connection, it may heat up by the use of a strong field current, increasing the resistance and thereby cutting down the current in the field and enabling the motor to speed up. This is not liable to happen in the usual way.

Of the two connections shown in Fig. 1 the one with the field wired as shown by the dotted line (X) will give lower speeds for a stated load and field rheostat setting, because the current flowing through the field will be a little greater.

Often the low-voltage release coil is connected across the line independently of the field through an external resistance in series with it. The chief disadvantages of having the low-voltage release coil in the field circuit are that such an arrangement is rather uneconomical of energy consumption, the coil must be bulkier and therefore more expensive to build than otherwise, while there may be a tendency for shut-downs to occur on account of the coil heating to such an extent at heavy loads, in conjunction with low voltage and high field rheostat setting, that the magnetism which holds the release fails to hold the handle, resulting in the opening of the circuit.

On the other hand there is an advantage in having the release coil in the field circuit, for should the field open the release immediately opens the circuit. In case a motor through overload, heating, or insufficient range of the field rheostat, is unable to maintain its speed with the connections shown by the full lines it may be worth while to change the connections to those shown dotted, both as in Fig. 1.—I. L. K. R.

House Wiring Emergency Light

The diagrams in Fig. 1 show methods of wiring when a master or emergency switch is used for the control of the lights in a house. With this arrangement it is possible to light all the lamps from a single switch; this can be located in any room of the house. As long as the master switch is closed it is impossible to turn out the lamps at the local switches that normally control them. This wiring system must not be installed for a circuit of more than 660 watts as that is the maximum permitted on a single pole switch; then two or more master switches should be provided.

When a lamp is to be controlled only by the master switch the connections at A, shown in Fig. 1, can be used.

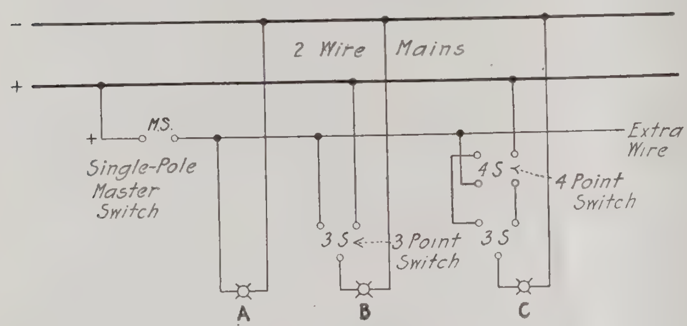


FIG. 1—SYSTEMS OF EMERGENCY WIRING

At B, the lamp is shown as controlled by a single switch in addition to the emergency feature. In this case a three-point switch takes the place of the common single pole switch.

The arrangement at C allows for the lamp to be controlled from two switches in addition to the master or emergency switch. In this case a four-point switch takes the place of one of the three-point switches which are sometimes used. As many four-point switches as made necessary by the conditions, may be placed in this circuit.

It should be noted that an extra wire must be taken from the mains for properly connecting the master switch to the system.—*Edward V. Legler.*

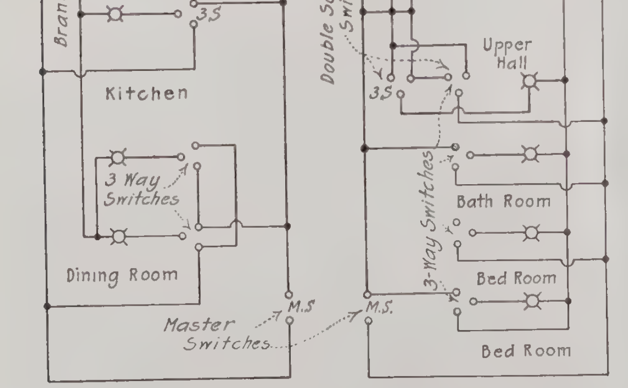


FIG. 2—HOUSE WIRED FOR EMERGENCY LIGHTING

The plan in Figure two shows a similar wiring scheme, for a complete house, on the assumption that the two-wire system is used. Two single pole emergency or master switches are indicated, one controlling the four living room lights, while the other controls the remaining first floor lights.

The use of single pole switches will undoubtedly save time and wire, the connections being simpler than with the double pole type. According to Rule 22 C, class C of the National Electric Code, not more than 660 watts are allowed on a single pole switch; hence at least two master switches must be used and these may be placed in the same or in different bed rooms. It would be wise to consult the local wiring rules as to the use of single pole switches in this class of wiring.

All the other switches indicated are of the three-point type, sometimes called three-way switches. It will readily be seen that if the lamps are in keyless sockets or out of reach, it is impossible to turn them off by their own switches when the controlling master swith is closed. When the master switch is open, however, the control of the lights is independent of it.

Switches are indicated for the bed room lights, and according to common practice, at least one of the bed room fixtures should be controlled by a switch placed in the room just inside the door so as to be available and save groping around after the fixture when entering in the dark.

If the switches as shown in Fig. 2 are not used, it will be necessary to run three wires in each bed room fixture, one of the wires bridging the fixture switch and leading out to the master switch.

Where two or more switches control the lights on one fixture as in the living and dining rooms, only one of these need be a three-way, unless it is desired that all groups of lights be controlled by the master switch.—*Orion Hurst, Mornstown, N. J.*

Causes and Remedies for Sparking Dynamos

E. L. BOYD, LORAINE, ILL.

"The machine was sparking badly at the brushes; the sparks were blue, and when the dynamo was shut down, the commutator was found to he rough and pitted." And such were the troubles experienced by J. S. as recently set forth in these columns. The dynamo is a low voltage direct current machine of 3 K.W. capacity furnishing current for a moving picture show. Where this generator is located is not made known.

The reason for such ills should be first determined before attempting to cure the trouble. The cause for most sparking of small isolated generators is an accumulation of foreign matter on the brushes. Dust settling on the commutator is quickly picked up by the brushes, preventing a good contact thus a small arc will follow which will leave rough places on the brush surfaces. If such operation is continued the brushes will become covered with rough places, allowing the copper to collect on their surface. Grease will aid in the rapid collection of foreign matter on the brushes, and must therefore be kept off the commutator.

Moving picture operators will often experience dynamo troubles because the generator is located just below the picture machine. In such installations, which are faulty to say the least, the burned carbons of the lantern will make dust which usually settles on the commutator. Naturally under such conditions arcing is set up between the brushes and the commutator, and the polished or smooth surfaces soon become scratched and pitted.

The commutator should be smoothened with sand paper fastened on a curved surface of the same radius as the commutator. The writers practice is never to use emery cloth. Clean the brushes and see they do not chatter when the generator is up to speed, for proper operation can only be maintained with brushes well set with an even pressure and a smooth commutator for good contact.

It is very likely that in this case the troubles are due to the brushes collecting dirt or carbon dust from the picture machine arc lamps. The pitting may also be due to the arc formed under the brushes due to poor contact. Other causes may be named as a ground on the commutator and a short circuit or perhaps an open coil, but these are rare occurrences and then the trouble is usually localized.—*E. L. Boyd.*

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Building Up the Lighting Load

By M. William Ehrlich

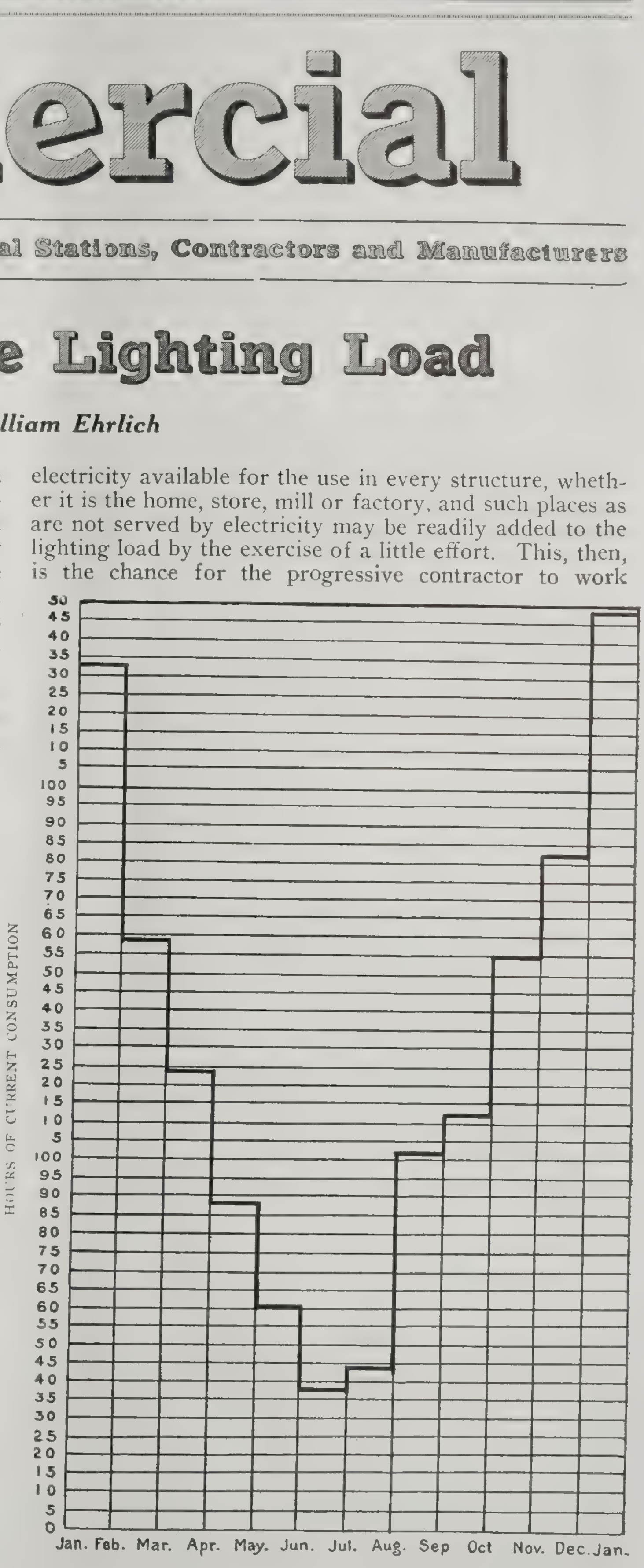
This is the propitious time for commencing a campaign to increase the lighting load because of the fast approaching Fall Lighting Season. A graphic presentation can in this case, tell more than a collection of phrases, and for that reason the diagram in Fig. 1 is resorted to. By close perusal it will be realized why the lighting load has been so low in the past few months, and also that the hours in which artificial light is used is rapidly increasing with the coming of the fall.

This applies to residential lighting and the small store, using current only between the hours of 7 a. m. and 10 p. m. Of course, there is very little use of artificial light during the day time, the greater part being consumed in the late afternoon and evening. On this basis the total in which a small consumer would use electricity for lighting is approximately 1545 hours for the whole year. Out of this aggregate, 45 per cent. of the consumption is represented by the 4 months of September, October, November and December.

That it is profitable to handle the small consumer, including the residence load and that of the small merchant, is no question, as the greater part of many electric services is made up of this composite lighting load. Many people are now returning to their homes, and in many instances these are being renovated; factories and mills are being erected all over the country, and the old installations are going through a process of remodeling and repairs for the coming season. Now, many of such places have no electric light service, and some that are so arranged may be found to be antiquated in equipment. The new electric incandescent lamps make the use of electricity available for the use in every structure, whether it is the home, store, mill or factory, and such places as are not served by electricity may be readily added to the lighting load by the exercise of a little effort. This, then, is the chance for the progressive contractor to work

TABLE I—COST OF ELECTRIC LIGHTING

City	Cost per K.W. hr.	Cost per 1,000 Tungsten Lamp	Candlepower hrs. Nitrogen Lamp
Altoona	7.3c	8.03c	5.84c
Baltimore	8.5	9.35	6.80
Brooklyn	11.0	12.10	8.80
Chicago	7.2	7.92	5.76
Detroit	6.0	6.60	4.80
Milwaukee	8.8	9.68	7.04
New York	8.0	8.80	6.40
Pittsburgh	7.8	8.58	6.24
Washington	10.0	11.00	8.00



MONTH OF YEAR

THE USE OF ELECTRIC LIGHT THROUGHOUT THE YEAR

hand in hand with the central station and carry the campaign to a successful finish.

With the many inexpensive fixtures of attractive designs and the extensive line of glass and metal reflectors now on the market, it only becomes a question of how a prospect is approached. People of even the most humble homes realize the advantages and comforts to be gained by the use of electric light over any other form of lighting, but they seem to be misinformed as to the cost of the electric service.

How to combat this general belief, is not a serious problem when attacked from the right angle, and some figures are therefore presented as an aid in this respect. The usual competition met in a large city or progressive town, is that of gas lighting, whereas in smaller towns and villages, the use of kerosene and gasoline lamps are still in vogue. It seems that the use of candles as a form of illumination has been long ago recognized as an expensive medium, and on this account no consideration will be given this item.

As to gasoline lamps. These contrivances are a dangerous fire hazard, and usually consist of a pressure tank, with copper tube delivery, requiring alcohol for starting. They need considerable attention, so that the cost for maintenance and depreciation for each lamp in use, will even exceed $3.50 per year. For each 1,000 candlepower hours, the gasoline lamp will consume approximately 1.3 gallons of fuel, and at a cost of 15 cents per gallon, the cost for gasoline only would be 19.5 cents.

The kerosene lamp may be classed as dangerous as the gasoline equipment, and it certainly has numerous fires to its credit. Under average conditions it will consume 1.1 gallons of oil for each 1,000 candlepower hours. With the price of kerosene at, say, 15 cents per gallon, the cost would be 16.5 cents. Of course, the price of kerosene and gasoline varies in different localities and such existing values should be substituted for those given above.

Considerable improvements are attributed to gas lighting, chiefly among them being the inverted mantle. For an average size the gas consumption may be taken as 105 cubic feet for 1,000 candlepower hours and with gas at $2.00 per thousand cubic feet, the cost of illumination would be 21 cents. However, the open burner is more extensively used because of the upkeep and renewals of mantles. This type of burner consumes about 400 cubic feet of gas, so that at $2.00 per thousand, it would cost 80 cents for 1,000 candlepower hours.

Now as to electric lighting in comparison with the foregoing, consider the tungsten incandescent lamp for the small consumer, requiring 1,100 watts for each 1,000 candlepower hours. With current selling at even 12 cents per kilowatt hour, the cost would only be 13.2 cents. The nitrogen or gas-filled lamp offers still greater economy, and even in the small sizes the current consumption for 1,000 candlepower hours is only 800 watts. With the same price for electricity, the cost would then be 9.6 cents.

As against these assumed cost values, let us examine some actual charges for electric lighting service to the small consumers in several localities. Such figures are shown in Table I, which gives the average rate per kilowatt hour, on the basis that the monthly consumption is only 30 K.W. hrs., and the comparative figure of what 1,000 candlepower hours would cost at the corresponding rate named, for tungsten and nitrogen lamps.

It will be seen that electric light is cheaper even on the assumed prices of oil, gas and current as before, and where the price of electricity is as given in the above tabulation any one can readily be convinced that they are virtually throwing away money in these days of efficiency and economy by not using electric lights. Of course, with an increase in consumption, the cost may be still further reduced. Armed with this information, and proper methods of presentation, there should be no difficulty in increasing your lighting load, as everybody wants electric light in the home. Get your audience, show the rate-schedule and hammer away.

Jingles as Business Promoters

Most of us realize that "advertising pays," but we often find it quite a difficult task to keep the advertisements from being dry reading. When that happens, the "jingle" is sometimes resorted to.

The views of the Society for Electrical Development are that people will read a simple rhyme when they would not "look" at a sound argument. With this in view, the Society has prepared several rhymes to show that they can be made to carry a message that awakens sufficient interest to induce the reader to absorb the more serious appeal that is in it.

The following jingles are designed as a means to get people to do things electrically, and such form of advertising may also be used in connection with window displays by having the jingles neatly lettered on small cards.

Jingles Singing The Praise of Elecricity

Cheer up! Be gay!
In this our day,
All people say:
"House-work is play
If done Electrically."

Electricity
Has come to be
A wondrous force
To humanity.

Electric Light
And pow'r and heat
Help make our life
A pleasant treat.

Here are some on electric light

In General

Their home is neat
'Tis quite complete,
So comfortable,
It can't be beat.
And every night,
It's gay and bright,
For in this home
There's 'Lectric Light.

The Porch Light

Our health to heed,
Pure air we need,
So out of doors
We sew and read,
Though dark the night,
Our porch is bright,
Because we have
This nice Porch Light.

The Night Light

Convenient, small,
A light in hall,
Will often Save
A bruise or fall,
For in the night,
If roused by fright,
You're safe when shines
That small Night Light.

For use in House-Wiring Ads.

For clear, safe light,
To cheer the night,
For comfort, heat,
And real delight.
Men all agree,
The home should be
All wired up
For Electricity.

Electrical Appliances—Reliable
Safe and Clean
Electrical
Appliances
Are truly good
Reliances.
For costing less
You must confess,
For safety and
For Cleanliness

Boosting the Vacuum Cleaner

Some time ago Prof. Alford, of Purdue University, who is interested in securing employment for students during their spare time, conceived the idea of purchasing a vacuum cleaner which could be loaned to the students, enabling them to do cleaning work for which the machine is adapted. The plan was approved by the university authorities, and the college Y. M. C. A. purchased one of the smaller sized Western Electric vacuum cleaners.

A letter was sent to the families of the university faculty, announcing that the cleaner was available, with an operator, at 30 cents an hour. Twenty cents of this goes to the student for his services in running the machine, the remaining 10 cents going to the association for maintenance of the equipment. By a slight change in the construction of the machine, the outfit at Purdue has been made portable in two ports. The demand for the use of the machine has been steadily growing, and if it continues at its present rate, will necessitate the purchase of a second machine in the near future. The present cleaner is busy practically all of the time and earns about $20 a month for the students.

Before sending out the cleaner, Professor Alford requested the department of electrical engineering at the university to test it for current consumption. This was done, and it was found that, at the cost price of current the average cost per hour for running the machine is only about ¾ of a cent.

How This Manager Secured New Contracts

HOW to increase the amount of small commercial business that ordinarily uses gas and how to improve the load factor of stores that have both gas and electricity and use gas for long-hour burning, is a broblem that must be solved by every lighting company in the country. The way this difficulty was successfully met in one instance by developing a new rate, is due to the ingenuity of E. R. Davenport, Sales Manager of the Narragansett Electric Lighting Company, of Providence, R. I. He found that most consumers of the small class are more or less meter-shy, and he therefore set to work to get them away from thinking about the meter and, at the same time, wanted to make a rate that would insure to the company a satisfactory return per kilowatt hour. Instead of giving them a straight flat rate, he made up a combination rate that went down in the scedule as "Lighting Rate C," as reproduced herewith.

A study of this schedule will show that almost all of the bill is definite and only a small percentage is indefinite, and the customer knows when he makes the contract within a few cents of what his lightning bill is going to be every month.

That the manager showed good judgment in sizing up the situation is very clear. The rate became effective October 8, 1913, and between the 5th day of November and the 31st day of December 97 contracts were obtained, totaling 152.6 kilowatts of demand, with an estimated income of $21,147.32, which figures out $138.58 per kilowatt connected and an average income per kilowatt hour of 6.4 cents.

During the year 1914, 421 contracts were obtained. Of this number 344 were original contracts and the balance were change-overs.

Making allowance for some of the change overs, which represented a reduction, the net increase in estimated income for the year, due to the development of the new rate, was $15,700.00.

An important feature of the rate is that it induces long-hour consumption by certain classes of stores, such as small drug stores and saloons which have both gas and electricity connected and normally burn electricity only during peak hours, while the gas is used for long-hour burning. Examples of increase in the percentage of exclusive long-hour electric users are given in

Table 1—One Year's Increase in Business

Before adoption	Class of Business	Since adoption
10.5 per cent.	Drug stores	49.0 per cent.
3.3 per cent.	Saloons	46 7 per cent.
9.7 per cent.	Restaurants	26.7 per cent.

When the connected load warrants it, a limitor or excess indicator is used in connection with a watt-hour meter.

This rate, it will be noted, is the same as the rate very generally used in connection with excess indicators, plus a small kilowatt-hour charge, which serves as a check on the user and further check is afforded by the fact that no lamps are furnished free, either for original installation or renewal.

The customers who have been obtained on this rate comprise small drug stores, restaurants, garages, liquor dealers, milliners, men's furnishings stores, shoe stores, lunch rooms, candy stores and bakeries, with a demand ranging from ¼ to 4 kilowatts.

LIGHTING RATE C.

EFFECTIVE OCTOBER 8, 1913.

CHARACTER OF SERVICE

This rate is for customers signing a one year's contract for a demand of ¼ kilowatt or over. Current may be used for all purposes.

RATE

Demand in Kilowatts	Service Charge per Kilowatt of Maximum Demand per year	Current Charge per Kilowatt hour
¼–10	$120.00	.01
10–25	96.00	.01
25–50	72.00	.009
50–100	48.00	.009
100–200	30.00	.008
200 and over	24.00	.008

DISCOUNTS

The above rates are net.

SERVICE CHARGE

One twelfth (1/12) of the Annual Service Charge shall be due and payable monthly.

The company may at it's option supply current under this rate to customers whose demand is ½ kilowatt or less at a fixed charge per week or month, in which case the amount of the charge and the hours in which current may may be used shall be specified in the contract.

The company reserves the right at any time to install time switches, watt-hour meters, maximum demand meters or excess indicators or other instruments or devices to enforce the conditions of this contract.

LAMP RENEWALS

No lamps will be furnished free, either for first installation or renewals.

STANDARD RIDERS

2, 3, 4, 5, 9.

TERM OF CONTRACT

One year or over.

METERS

Under the above rate the Company will install one or more initial meters at its option. All other meters will be installed upon request of the customer at a rental charge of 50 cents per month per meter.

TIME SWITCHES

Time switches furnished under this rate at a rental charge of 50 cents per month per switch.

For Your Business Sake Practice What You Preach

Numerous instances prove that many people in the electrical business still think that it does not extend to them personally. As en example we have the electrical dealer who hopes to introduce electrical devices into the homes of his community but himself uses gas for light and cooking, lets his wife turn the washer by hand, fans himself during the summer months with a piece of card board on a stick and otherwise adheres to the customs of his fore-fathers, meanwhile attempting to educate his fellowmen in the "Do-It-Electrically" doctrine. However there are exceptions, E. P. Smith, of Dubuque, Iowa may be named as one electrical dealer who has made his home electrical from cellar to garret.

The equipment serves not only to lighten the work of the Smith household but has the added distinction of serving as a permanent exhibit by which Mr. Smith is able to conclusively demonstrate and prove that the electrical household appliance is as necessary as it is practical. When a prospect says "Well it looks alright here in your store but I don't believe it'll work in my home" he is promptly taken to the Smith home where he sees that particular device at work. The bills for current consumption are open for his perusal and he has but to ask the domestic to get first hand information regarding results obtained with the devices. Mr. Smith is convinced that his scheme is the best for real sales results and it remains for the other electrical dealers to try this system of practising what they preach that they too may be able to reap the benefits in increased sales.

The lighting system starts at the curb where a boulevard post of special design stands sentinel. The illumination of the home and garage is solely electrical taking the form of direct and indirect system according to conditions met. Special circuits for emergency or burglar lights, controlled from several locations, light five lamps on the outside of the house and all the lights in the basement, first and second floors.

A two horse-power stationary vacuum cleaner in the basement with a remote control switch on every floor keeps the house clean. In winter the rooms are heated by a hot water furnace with electric thermostatic control and in summer they are cooled with twelve inch fans permanently fastened to the walls of the various rooms and eight inch portable fans that are capable of being placed where needed. The water supply which is heated in the summer months with an electric water heater, is furnished by a water cistern with an automatic electric control pump. The laundry is equipped with an electrically driven washing machine, an electrically driven and heated ironing machine, an electric iron and electric clothes dryer.

The cooking is done on individual units which have been provided for by equipping the kitchen and dining room tables with plugs and receptacles. The dining room is also furnished with a special electric cabinet with sufficient equipment to cook a light meal. In the sewing room a motor runs the machine and an electric iron has been provided for light pressing. The piano is played with a special electric attachment, current for which is supplied by a motor generator set. A ten station interphone system provides instant communication between any two units in the home and between the home and garage. The garage is electrically lighted and is equipped with a one-half horsepower motor which does grinding and polishing work. The entire equipment was furnished by the Western Electric Company.

Financial

Reorganization of the United States Light and Heating Co. of Maine, has been made effective and its successor, the United States Light and Heat Corporation, recently incorporated in the State of New York, has taken over the old company's properties. There is to be a bond issue of $100,000, of which $500,000 has already been issued, $3,000,000 non-cumulative 7 per cent. preferred stock held in voting trust and $4,000,000 common stock, both of a par value of $10 a share.

Commonwealth Power, Railway and Light Company and constituent companies announce July gross revenues, with intercompany sales eliminated, amounting to $1,182,520—an increase of 3.43 per cent. over July of te previous year. Expenses of operation increased 5.78 per cent. Fixed charges were $429,732. The balance after the dividends on preferred shars were deducted, was $82,667, an increase of over 5 per cent.

July gross revenues of the Dayton Power and Light Company inncreased 11.06 per cent. over July of the last year and net earnings showed a gain of 28.12 per cent.

Cities Service Company is making steady progress as evidenced by the July report. Gross returns amounted to $297,626, an increase of $25,989 over last year, and net totalled $283,255, an increase of $20,580.

Earnings report of the Cleveland Electric Illuminating Company, controlled by the Central States Electric Corporation, for July, in comparison with that month a year ago, shows that gross income was almost 7 per cent. in excess of last year's figures, while net increased nearly 8 per cent. Total gross returns amounted to $311,643; net earnings, after expenses and taxes, were $152,010, and the surplus, after payment of dividends, amortization and depreciation, was $85,415, compared with $75,957 in 1914.

Gross earnings of all the properties now owned by the subsidiaries of the American Power & Light Company, which controls the street railway systems in Buffalo, Niagara Falls, Lockport and adjacent territory, irrespective of the dates of their acquisition, for the twelve months ended July 31, 1915, were in excess of$7,150, 000, while net earnings were more than $3,375,000.

The International Traction Company reports a smaller gross operating income for the year ending June 30, than in the previous year, though net earnings and surplus made considerable gains. The gross figures were $6,748,779 ,a reduction of $71,570 and net were $2,813,051, an increase of $48,670.

Authority has been granted the Consolidated Electric Company, the reorganization of the United Light and Power Company and a new subsidiary of the Great Western Power Company, by the California Railroad Commission to amend the mortgage securing its $2,500,000 general mortgage 5 per cent. forty-year bonds in order that the company may deal with its own franchises, and thus eliminate the right of a number of bondholders to modify the trust deed.

Galveston-Houston Electric Company continue to show less in revenues. A recent report indicates a loss of 25 per cent. in gross income and a decrease equal to more than 47 per cent. in net.

A falling off in earnings of the Aurora, Elgin and Chicago Railroad Company was shown when it was known that there was a loss of $28,813 in gross operating revenues over last year, an increase of $6,000 in operating expenses, and a loss in net of $34,000. Figures are: gross, $163,746; net, $39,881.

The Blackstone Valley Gas and Electric Company, a Stone & Webster organization, reports that gross earnings for the year ended June 30, 1915 increased $17,470 to $122,003 in June, accompanied by a gain of $9,579 in net income, which amounted to $48,026, and an increase of $7,114, in surplus earnings, which were $27,353. For the twelve months' period the company reports a gross income of $1,389,223, an expansion of $77,273 over the preceding year. Net earnings totalled $554,742, an increase of $83,390, and the surplus balance of $324,714 showed a gain of $65, 249.

Kuhn, Loeb & Co., Lee Higginson & Co., and Blair & Co., are to be the managers in carrying out the plan for the reorganization of the Kansas City Railway & Light Company of Kansas City, Mo.

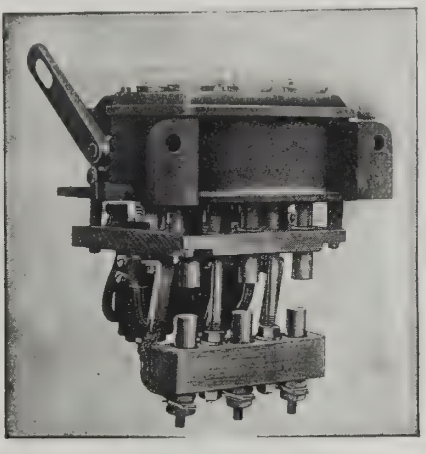
Articles of incorporation for the Independent Heat and Light Company were filed in the office of the county clerk today. The capitalization is to be $70,000 and the purpose of the organization is to manufacture and sell a patented gas appliance.

New Products And How to Use Them

A Monthly Review of New Apparatus ,Equipment and Specialities of Known Value

A NEW LINE OF OIL CIRCUIT-BREAKERS

Announcement has been made by the Westinghouse Electric & Mfg. Co., of a new line of small-capacity hand-operated single-throw oil circuit-breaker known as the type H, for voltage up to 2500 A. C., and capacities up to 100 amperes. On direct-current they can be used for voltages up to 250 where the maximum short circuit that they may be called upon to trip will not exceed 500 amperes. Designs are available for indoor and outdoor use.



THREE-POLE INDOOR WALL-MOUNTING TYPE H OIL CIRCUIT-BREAKER. PLAIN-OVERLOAD TRIP TANK REMOVED OPEN

The type H oil circuit-breakers are small-capacity hand-operated single-throw breakers for indoor use (dustproof wall mounting) and outdoor use (weather-proof, wall or pole mounting.)

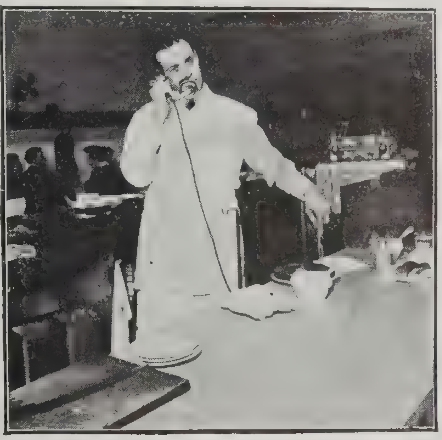
These breakers supply the need for a simple, reliable, and at the same time inexpensive oil circuit-breaker for use in general industrial applications utilizing low voltages. They are particularly useful for controlling motor circuits and otherloads of low factor ;for although the rated voltage is low, excessive arcing would occur even with low voltage when using an air-break switch at low power factor, thus making an oil circuit-breaker advisable.

Due to the excessive moisture and drippings inherent in mines, the weatherproof breakers find ever-increasing uses as low-capacity and low-voltage breakers in such service.

The advantages features claimed for the type H oil circuit breakers are:—compactness of form; ample contacts of the "butt" type; submersion and opening of all contacts under coil; quick opening of contact; open position maintained by gravity; tanks removable without disturbing the operating mechanism or contacts; making inspection easy; self-contained multipole operating mechanism.

NEW RESTAURANT TELEPHONE DEVICE

The old order changeth and even the old fashioned waiter with stentorian voice is doomed to become a back number. The Western Electric Company has recently put on the market a very interesting device for use in restaurants of the dairy ilk. Instead of contributing to the noise and rattle by shouting your



order in a loud tone, the waiter simply takes a hand telephone from a convenient nook and quietly gives the order to the chef below. The chef is supplied with a chest transmitter and watch case receiver, which does not in the least interfere with his culinary duties. There is no time lost or confusion—and you eat in peace.

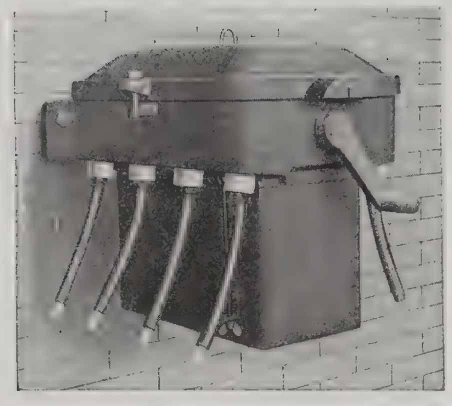
An extensive line of oil switches, type D, for voltages up to 7,500, has recently been announced by the Westinghouse Electric & Mfg. Company. These switches are non-automatic and are suited for a wide range of application. They are made for indoor service in switchboard-mounting, direct wall-mounting, and remote-control wall or pipe-mounting styles; and for outdoor service, pole or subway-mounting.

The direct wall-mounting style is particularly adaptable to motor installations on account of the facility with which it may be mounted on any support convenient to the motor operator. The lever and handle extend outward over the oil tank so that the switch may readily be mounted against a wall, or any vertical support.

The remote-control wall or pipe-mounting style allows switch to be mounted at a convenient point away from switchboard and operated from the switchboard or other point as desired.

The outdoor type D oil switch, is particularly adapted for controlling lines where they enter buildings, branch feeders from the main lines, sectionalizing feeders, or any of the numerous purposes for which an outdoor type of switch may be utilized on distribution systems.

The subway-type oil switch is for mounting in subways, manholes and other places where a switch may be required to be



OUTDOOR SWITCH FOR WALL OR POLE MOUNTING, 4500-VOLT, 200-AMPERE, FOUR-POLE, SINGLE-THROW

operated submerged. The subway-type oil switch is made in two, three or four-pole single and double-throw for voltages up to 4,500 and capacities up to 200 amperes.

Characteristic features of this type of switch are: knife blade contacts submerged in oil; live parts carried on insulating supports affording a high quality of permanent insulation between adjacent poles, and between the frame and live parts; small space required for mounting; accessibility of parts for purpose of inspection and repair; enclosure of all live metal parts; and low first cost.

The Robbins & Myers Co., Springfield, Ohio have just recently developed the motor-generator set shown herewith, for charging batteries for automobiles, motor beats, etc.

They may be operated from 110 and 220 volt direct current or 115 and 230 violt, 60 cycle alternating current.

Three sizes are made, 80, 150 and 250 watts.

The 80 and 150 watt outfits are light in weight and can easily be moved about; they are fitted with an oak base so they can be placed on the running board of a car without marring the finish. The 250 watt size is usually installed in a permanent position in the garage.

Eighty and 150 watt sets are regularly furnished with 10 feet of duplex cord and detachable plug on the motor side and with 10 feet of heavy duplex cable with universal lead covered test clips on the generator side. These leads are subsantially anchored to the frame of the machine.

The 250 watt sets have leads brought out of the frame through bushed holes. The ends of these leads are fitted with brass connectors. Four leads are brought out of the generator side, two being the line leads and the other two intended for connection to the field reostat.

To use, a plug on the motor cord is screwed into a lamp socket and the switch turned on. After the set has attained full speed, the generator terminals are connected. As the generators are shunt wound, either clip can be connected to either terminal of the battery and the generator polarity will adjust itself automatically to the polarity of the battery. After the battery becomes fully charged the generator may be left floating on the battery without injury.

WELDING DEFECTIVE CORES IN PAPER MILL

By using the Prest-O-Lite process of oxy-acetylene welding, broken cores can now be repaired in nine minutes. No filling material is used as a method has been found for handling the welding operation so that sufficient strength can be obtained with the material flowed into the weld from the pipe itself. Occasionally, however, a small quantity of filler rod has to be added to insure a joint that will be as strong as the rest of the core itself.

The two sections of pipe are prepared by simply cutting off in a machine with the regular cutting-off tool. The ends of the pipe are not beveled as the extra metal is needed where filling rod is not added.

Th cores are steel tubes three inches in diamenter and average about fifty inches in length. During the welding operation, they are slipped over an iron arbor of the same diameter as the shaft on which the roll is designed to run, to insure perfect alignment with the longitudinal center.

OUT OF DOOR ILLUMINATING

One of the most interesting out-of-door illuminating schemes recently installed in the middle West, is that of the comprehensive lighting of the new plant of the Eli Lilly Company, near Greenfield, Indiana.

The power is purchased from the Terre Haute, Indianapolis & Eastern, and the success of this traction line with "Golden Glow" interurban headlights led to the suggestion to try "Golden Glow" harbor range lights, manufactured by the Esterline Company, of Indianapolis. Accordingly, a trial installation of ten lamps was made, burning five in series on the 600 volt interurban circuit and the result was so satisfactory that the

entire equipment was purchased and permanently installed. The electrical work was placed by the Sanborn Electric Company, of Indianapolis.

The small illustration is of the type of lamp used, a standard "Golden Glow" headlight which was originally designed for Government harbor range lights, in which service they are extensively employed.

These lamps are mounted on concrete bases and are so close to the ground as to be unnoticeable in the day time, and at night it is hardly possible, from the road, to tell where the sources of light are. The lamps are all equipped with 120 volt to 250 watt G-30, concentrated filament, gas filled, Mazda bulbs. The fact that no maintenance is necessary with the mirrored reflectors in the "Golden Glow" lamps, and the long life of the bulbs, makes the installation an ideal one. The wires are all laid in conduits.

SOCKET BASE

A new socket base is offered by the H. T. Paiste Co. which fits all the shells for their "Multipo" or "New Wrinkle" types of sockets. This base is designed to fit on the 10 ampere openings of round base pipe taplets, both those with a single opening and the gang types with two, three or four openings.

To install these socket bases, remove the switch bar and ring which are used for fastening switches and other surface fittings. The base entirely covers the opening of the pipe taplets.

ALL THESE SOCKET SHELLS FIT THE PIPE-TAPLET SOCKET BASE

PIPE-TAPLET SOCKET BASE NO. 4001 "UNO" SHADEHOLDER WITH SCREW FASTENING

No tap wires are required to fasten these socket bases to the main wires. The main wires are bared for half an inch and slipped under the heads of the binding screws.

The Key, Keyless and Pull socket shells can be used on the same base.

Paiste socket shells are now furnished with the threaded bead so that the "Uno" (one piece) shadeholders can be screwed on them. This is much the quickest and easiest method of shadeholder fastening and secures a very rigid shadeholder.

The Hart & Hegeman Mfg. Co. are the sole selling agents for Paiste material.

BRYANT NO. 509 TYPE "O" SWITCH AND JUNIOR RECEPTACLE COMBINATION

The device illustrated is primarily designed to provide an attachment plug receptacle controlled by a switch, which can be installed complete in a regular 1-gang flush outlet box. If the combination is installed with the feed wires coming through the switch end it will control the device connected to the attachment plug, making it unnecessary to break the circuit by removing the plug. This permits a quick make and a quick break. The switch has an indicator which is especially valuable when it is used in connection with a device which of itself does not show whether current is being used.

This switch and receptacle combination may also be installed with the receptacle end toward the feed wires, when current can be taken off of the receptacle independent of the switch. In

COMBINATION OF RECEPTACLE PLUG AND D. P. TYPE "O" INDICATING SWITCH

such a case the switch can still be used for controlling other outlets. It is possible, therefore, to place one of these devices in a single outlet box previously used for a switch only, and take off current at this point by means of the Junior receptacle unit.

LOW COST 33000-VOLT SUBSTATION

A low cost industrial type of wooden pole outdoor substation is shown herewith. The high tension 3-phase air break switch is mounted on two poles, the choke coils and carbontetrachloride fuses being mounted just above the transformers, which are at ground level.

The control switch is operated by means of a square vertical steel shaft at the lower end of which is a locking type handle. Thisoperating mechanism is permanently grounded, thus eliminating danger to the operator of static shocks.

The high tension switch, choke coil and fusing equipment is of the standard form, manufactured by the Delta-Star Electric Company, Chicago.

Conference of Utilities Bureau of Valuation

A conference on the principles and methods used in the valuation of public utilities will be held in Philadelphia, November 10 to 13, under the auspices of the Utilities Bureau. The Utilities Bureau has recently undertaken the publication of the "*Utilities Magazine*," through which as a medium, it plans to keep officials and city residents in touch with all interesting and useful information concerning utility matters.

Mr. Morris L. Cooke, of Philadelphia, is acting director of th bureau which was founded November, 1914.

It is creditably reported that Secretary Daniels is planning to ask the American Institute of Chemical Engineers and the American Electro-Chemical Society to nominate members for the proposed Naval Advisory Board. Electro chemists, it had been pointed out to Mr. Daniels, have played a very important part in the development of industry and their value to a board such as he is organizing would be very great.

THE "BEST" JIFFY ATTACHMENT PLUG

The Jiffy Swivel Attachment Plug shown in phatom in the illustration, is the latest wiring device and is being put on the market by the Best Electric Company of Pittsburgh, Pa.

Important features are embodied in this plug; it has a new strain relief which the manufacturers claim takes the full

stress of any pull or jerk on the wire, and eliminates the necssity of a knot in the wire.

This Jiffy Plug is made of asbestos composition throughout—a material that cannot crack nor melt, and has proven very durable.

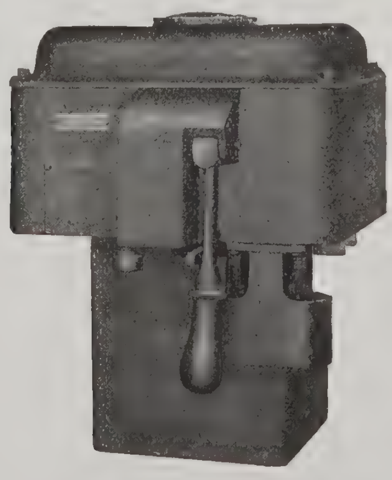
But to the fixture manufacturer or the contractor, perhaps the most interesting feature of the Jiffy Plug is the new time saving wiring idea—a feature that the manufacturers claim cuts the ordinary wiring time squarely in half.

In wiring, both wires are cut even, and there is no fishing in holes for the lead in wires. In assembling only one screw is removed, and the contact wires are then attached in the open. There are no parts to work loose, and the wiring of this plug has been reduced to utmost simplicity.

A special bulletin illustrating and describing this plug can be had by addressing the manufacturers, the Best Electric Company, Pittsburgh, Pa.

IMPROVED INDUSTRIAL TYPE OIL SWITCH

This improved type of oil switch is used extensively in industrial establishments to control and protect induction motors up to 2,500 volts and 300 amperes. It can be mounted on a wall,



TYPE F, FORM K-20, OIL-SWITCH WITH AUTOMATIC SERIES OVERLOAD TRIP AND LOW VOLTAGE RELEASE

post or other vertical flat surface, or by means of suitable supports on the machine operated by the motor. The switch is made by the General Electric Company in both non-automatic forms; the first simply to start and stop the motor, and the second to cut off current from the motor automatically on the occurrence of an overload greater than that for which the overload trip is set.

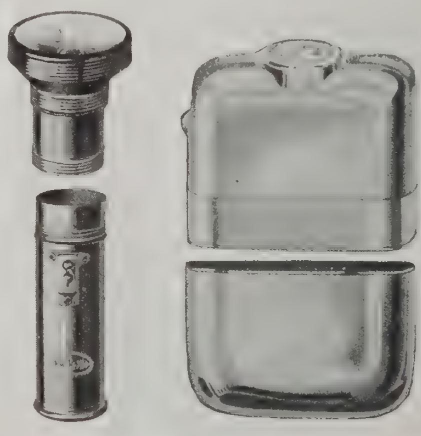
Through a recent improvement in the design of the mechanism, a low-voltage trip can be added to the automatic switch as an attachment at any time. To the non-automatic switch, either a low-voltage trip or a series-overload trip, or both, can be added whenever desired. Both means of tripping are mounted inside the switch cover.

Up to 550 volts (except on 110 volt, 60 cycle circuits, where the trip coil only is sufficient), an auto-transformer is used in place of the resistance previously required in series with the low voltage tripping coil. This transformer has taps to which proper connections can be made for the operating voltage. For 2,200 volt circuits, a new type voltage transformer replaces the transformer and series resistance used heretofore. The use of the new auto-transformer, or voltage transformer, makes the watt loss in the low-voltage device practically negligible.

KWIK-LITE PRODUCTS

The telescope vest pocket case (illustrated herewith) is unusually neat and attractive; it consists of two parts drawn from solid sheet brass, and is so constructed as to telescope at the centre. When pushed together they firmly lock; with a slight pressure on the sides they can be pulled apart and the battery easily inserted. There is not a hinge or clasp on the entire case.

Another device of much merit is the telescope metal tubular case (see illustration). It is absolutely non short-circuiting and is very strongly made of tubular brass. The lower piece telescopes of the upper near the centre, this insures maximum strength and permits engaging the screw threads without effort. The lens is secured by a separate screw and ring, which allows a broken lens to be replaced without procuring an entire new head.



Brascolite Receptacles

The receptacles illustrated herewith are now being furnished as regular equipment with Brascolites as manufactured by the Luminous Unit Co., St. Louis, Mo. They present a quite radical departure from present practice in that the use of pigtails is eliminated and thus the expense consequent to the making of a soldered and taped joint is also eliminated.

The contact terminals are of the regular screw type, but are enclosed or protected by porcelain, which is a part of the receptacle body. An aperture is provided for the insertion of the wire and also for a screw driver to operate the terminal screws.

These receptacles are made in both medium and Mogul sizes

NEW APPLETON DEVICES

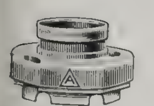
Fig. 1 illustrates a new Cord Rosette for use with ½ inch Rectangular Unilets. Fig. 2 illustrates a new attachment plug receptacle for use with these same fitings and take the standard Hubbel caps. Fig 3 is a new one-piece receptacle for use with Octagon Unilets 2¾ in. diameter. Fig. 4 shows a new cover designed for Switch Unilets for the new Hubbell Duplex Receptacle. Fig .5 shows a new ceiling Box Adapter which will be found very useful for installations where a ceiling box without ears has been installed and it is desired to use a cover on same. The adapters are fitted with two screws for holding the cover.

Fig. 6 shows the new Appleton Conduit Hanger which is furnished in two parts, a base as shown by Fig. 7 and a clip as shown in Fig. 8 The clip is snapped over the conduit and slipped into the base after which the screws on the side is tightened and a firm grip made on the conduit. The hanger is made from steel and either enameled or sherardized.

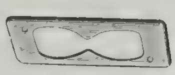
Fig. 9 illustrates the Appleton Pipe Clamp which is constructed of steel and is therefore not only light in weight but practically indestructible. This makes an inconspicuous fastening where the conduit is installed especially on tile, brick and concrete walls. It requires but a single screw or bolt to secure this in place and obviates the drilling of two holes. It removes the cost of one expansion bolt or screw and in an economical advance in conduit installation. The clamp is made for ½, ¾ and 1 inch conduit.

1

2

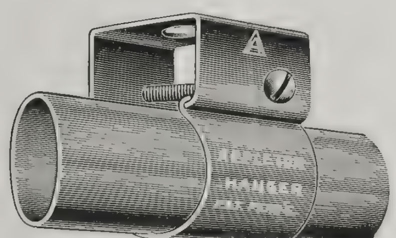


3

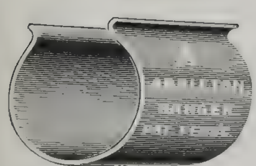


4

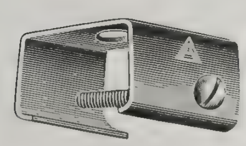
5



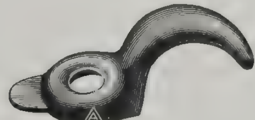
6



7



8



9

A NEW VESTIBULE TELEPHONE

The Connecticut Telephone & Electric Co., Meriden, Conn., has just placed upon the market a new vestibule telephone outfit. This is known as their cordless type. As will be noted from the illustration this telephone has a concealed trans-

mitter and receiver—to operate it is simply necessary to push the button and talk with your party in front of you. The person talking from the suite can be heard for a long distance from the vestibule telephone, due to a specially constructed loud talking receiver. There is nothing on the face plate except the card holders and buttons. Therefore there are no cords or receivers to be stolen, no hooks to be broken.

"WURDACK" SPACING SWITCH BOX

A new spacing type switch-box has recently been brought out by the Wm. Wurdack Electric Mfg. Co. This box is equipped with universal ears and is so constructed that any number can be ganged together. The sides on the inside of the bor can be removed making one continuous box with maximum amount of room for aligning switches. All boxes are ganged together, by bridging cars between the boxes. The short ear can be raised for old work or lowered for new work.

The box is made in a single type and is instantly adjustable to any particular style of loom box required. These "Wurdacks" can be taken to a job without previous knowledge of installation and then adapted to meet conditions found.

The Montreal Light, Heat and Power Company in its comparotive income account for July reports gross operating revenues of $474,879, nearly $14,000 larger than in 1914, and net earnings, after taxes, amounting to $255,186, a gain of $21,194.

A new corporation has recently been chartered in Delaware with a capital of $1,000,000 under the title of Latin-American Public Works Corporation. The activities of the new organization are to be directed especially toward the acquisition of concessions and contracts for public works in Central and South America. First hand studies of general business opportunities and prospects of building electric lighting and power plants will be made.

The Mohawk Electrical Supply Company has authorized an increase of stock from $25,000 to $50,000.

The Automatic Lighting & Power Company, Lancaster, O. has been incorporated with a capitalization of $50,00.

The Martinsburg Power Company of Pa. has reorganized under the name, Potomac Light and Power Company, in accordance with an agreement with the Hagerstown and Frederick Trolley line interests. The authorized capital will be $1,000,000.

The Devine Light, Power and Ice Company, of Devine, has been organized with a capital stock of $35,000.

Trade Literature

Superior Enameled Conduit is described in a leaflet just issued by the Sprague Electric Works, New York. This includes prices, weights and dimensions of rigid iron conduit.

Stage Lighting Apparatus is illustrated in a folder received from the Universal Electric Stage Lighting Company, New York.

Street Lighting Fixtures for series lamps are fully described in a pamphlet recently issued by the General Electric Company, Schenectady, N. Y.

Steel Boxes for Service, cut-out and panel board uses are described in detail in catalogue E4 of the Allsteelequip Company, Aurora, Ill.

Flashes From a Live Wire is the title of an interesting booklet containing an interview with a prominent manufacturer in connection with motors of the Robbins & Myers Company, Springfield, Ohio.

Electrical Instruments, including volt meters, ammeters, ammeter shunts and circuit breakers are illustrated with detail dimensioned drawings on the loose-leafs recently issued by the Roller-Smith Co., New York.

Telephone Cables are considered in the new booklet of the Standard Underground Cable Company, of Pittsburgh, Pa. This is a thorough treatise, giving specifications for different cables used in telephone work.

Battery Flash Light Lamps, both vest pocket and tubular types, are thoroughly described in a booklet of the Usona Manufacturing Co., New York.

Centrifugal Pumps are thoroughly treated in Bulletin 1632 of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. This book gives valuable engineering data with tables and curves. It should be of interest to all users of pumping equipment.

Centrifugal Blowers and compressors as manufactured by the De Laval Steam Turbine Company, Trenton, N. J., are listed in catalogue F just issued. This apparatus may be used for both fractional and very high air pressures for various service conditions. The book is thoroughly illustrated and includes detailed descriptions, together with engineering data and curves.

Lighting Fixtures for industrial and street lighting uses as manufactured b ythe George Cutter Co., South Bend, Ind., are described in Catalog 13. This book lists the various products and supplies, including ornamental posts and brackets which are necessary for such systems.

Switchboards for Small Plants are discussed in Bulletin 47050 of the General Electric Co., Schenectady, N. Y. These units are illustrated with dimensioned drawings showing various combinations of panels. Wiring diagrams of connections are also given.

The Supply Department of Thos. Cusack Co., Chicago, Ill., has issued a neat loose-leaf catalog descriptive of the various lines handled. These include small day and night signs, flashes, time switches and other specialties.

Multiple Mazda Lamps is the title of Bulletin 13E received from the National Lamp Works, Cleveland, Ohio. This publication is devoted to a discussion of the improved vacuum and gas-filled lamps, such as may ordinarily be used for lighting purposes. It is replete with useful information.

Engine Type Generators are treated in Bulletin 1093 of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. This catalogue gives detailed descriptions, with illustrations of the types of direct current machines above named.

Electric Light and Motor Wiring is the name of a book by G. J. Kirschgasser. It is of vest-pocket size and thoroughly practical in its treatise of wire and systems for lights and power. For sale by the Electroforce Publishing Co., Milwaukee, Wis.

Bulletin No. 79 of the Engineering Experiment Station, entitled Coking of Coal at Low Temperatures with special reference to the properties and composition of the products, was prepared by S. W. Parr and H. L. Olin. This paper presents the results of a series of tests showing that coke results from the low temperature process and retains tar form or constitutents, and may be used successfully with the suction gas producer. It is likewise adapted to use in domestic appliances when absence of smoke or soot is desirable.

Copies of Bulletin No. 79 may be obtained gratis upon application to C. R. Richards, Acting Director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

Circulation of the Strength of Electric Currents

Washington, D. C., September 3, 1915.

Probably the most accurate method for the determination of the value of the strength of an electrical current in absolute measure is by means of the Rayleigh current balance, in which the current to be measured is passed in series though two parallel circular coils of unequal radii, one of which is suspended from the beam of a balance. The distance between the planes of the coils is varied until the force of attraction between the two coils is a miximum, and the value of the force is obtained by adding weights to the other arm of the balance until its equilibrium is restored. Since the maximum force obtainable depends on the ratio of the radii of the coils alone, and not on their individual dimensions, it is only necessary to determine further the ratio of the radii of the coils, and this may be done with great accuracy by electrical means.

The constant of the instrument, that is, the maximum force per unit current for the coils in question, has been obtained in the past by interpolation between values of the force, calculated for various assumed distances of the coils, in the neighborhood of the critical value for which the force is a maximum. For, although the general formulas of Maxwell and Nagaoka give the value of the force for any two given coils, at any assumed distance with great accuracy, no formula has been heretofore published for calculating at what distance the force becomes a maximum. To supply this lack there is derived in a paper just published by the Bureau of Standards, Department of Commerce, entitled "The Calculation of the Maximum Force between two Parallel, Coaxial, Circular Currents," a formula which gives the critical distance as a function of the ratio of the radii. The latter part of the paper is devoted to the development of methods for facilitating the calculations. The formulas are illustrated by numerical examples and tables, and the new formulas are shown to give results in agreement with those derived by more indirect and laborious method of interpolation.

Copies of the publication, Scientific Paper No. 255, may be obtained on request of the Bureau of Standards, Washington, D. C.

Review of the Month

A Complete Record of Important News Edited for Busy Readers

The Kuhlman Electric Company have removed their plant and business from Elkhard, Indiana, to Bay City, Michigan.

The Genese Light & Power Company is going to furnish the town of Elba, N. Y., with electricity.

The common council of Madison, Wisconsin, has awarded to the Industrial Foundry Company the contract for installing an ornamental lighting system in the city.

John S. Rowan, doing business as the Rowan Electric Manufacturing Company, was a former employee of the Monitor Controller Company.

C. M. Gest & Co., New York, were the successful bidders on the contract for an underground conduit system in Springfield, Ohio. The work will probably be completed about October 15.

The P. & B. Mfg. Company, of Milwaukee, Wis., have increased their capital stock from $5,000 to $25,000 and have moved into larger quarters at 189 Fifth street.

Twenty-four decorative street lighting posts in the business section of the city have been installed in San Benito, Texas, by the San Benito Lighting Company.

Work on the installation of a white way system in the business section of Mankato, Minn., which has been long delayed, has finally been begun. The Sterling Electric Co. are in charge.

Plans are under way for the addition of another electric unit, a combined generator and turbine for the plant of the United Water, Gas and Electric Co., of Hutchinson, Kansas.

The Board of Public Works, of Meriden, Conn., has awarded the contract of 109 street lamp poles to the John I. Mott Iron Works Company, of New York.

The electric light plant of Callahan, Fla., is being enlarged by A. F. Carswell, owner and manager and liihts will be furnished for the city.

The United Electric and Water Company made an attractive display of their wares in the "Twice as Many Week," which they inaugurated recently in New Britain, Conn.

The contract for furnishing electricity to Brackenridge Borough, Pa., has been granted to the neighboring Borough of Tarentum.

The Hotpoint Electric Heating Company offered prizes for the best window display during May, and the prize of $10.00 was awarded to the Consumers' Power Company, Mankato, Minn.

Kansas Gas and Electric Company, a subsidiary of the American Power and Light Company, has acquired the electric light and power properties in Arkansas City, Kan.

The Indiana Utilities Commission in fixing rates to be charged by the Indianapolis Light and Power Company (July 30, 1915) said:

The city of Little Falls, N. Y., are now numbered among the progressive communities which are installing a White Way system. The Utica Gas & Electric Company have received the commission from the board of aldermen.

The prize offered recently by the Rice Leaders of the World Association for the best window display was awarded to the Manchester Traction, Light and Power Company, of Manchester. N. H.

It is understood that the suggestion of an English scientist that coal be burned in mines and the resulting gas utilized to produce electric power for general distribution will be acted upon, experimentally in the near future.

The work on the new power house for the city power plant in Baraboo, Wis., which will be used for generating electricity and for driving the pumps of the city water plant, is rapidly nearing completion.

The town board of Skaneateles, N. Y., has granted a franchise to the Niagara, Lockport and Ontario Power Company. The franchise covers the entire town of Skaneateles outside the village limits.

The Ford Madison Eectric Company has finished the construction of the new distribution system inthe West and now operates through the city from an entirely new system of poles and lines modern in every respect.

A new conract has recently been made between the city commission of Dayton, Tenn., and the Public Light and Power Co., reducing further the rates on electric power both to residences and business houses.

The Jovian Order will hold its thirteenth convention at Chicago, Ill., October 13th, 14th and 15th. The program outlined includes a regular business session and an extensive entertainment for all present.

The Electric Vehicle Association of America announces an increase in membership to 1,058, whereas only a year ago its membership was less than 500. During this same period the geographical section representation has increased from 2 to 16.

Lincoln Electricity Works is the new name used by the company formerly known as the Lincoln Electric Heating Ap-

pliances, Inc. No change other than the change in name is involved; the address as before, is Chicago, Ill.

The Bristol Company, Waterbury, Conn., manufacturers of recording instruments extensively used in power plant work, announces that they have been awarded a Grand Prize for recording instruments at the Panama-Pacific Exposition.

An electric cooking school and domestic science demonstration held in Albany, Ore., by the Oregon Power Company in co-operation with electric range manufacturers during the week of July 27-31 was successful.

The city of Jeffersonville, Ky., is planning to change the lighting system from the existing arc plan to the new mazda enclosed nitrogen lamp system. The United Gas and Electric Company are to be in charge of the work.

A seven-day week has been inaugurated at the plant of the Westinghouse Air Brake Co. This is the first time in years that the company's plant will be operating on Sunday. Officials of the company state that there are enough orders on hand to keep the plant operating at full capacity for two years.

The sales department of the Minneapolis General Electric Company during the week ending August 6th secured contracts for 319 electric customers with 211 kilowatts lighting load and 945 horsepower in motors and took orders for wiring 49 houses already built.

The Great Northern Railway Company will pump its water by electricity as soon as a 35 horsepower motor and pump can be installed. The Red River Power Company, a Northern States Power Company subsidiary, will furnish the electric power.

The entire holdings of the Warren Milling Company and the Warren Light & Power Company, of Sebree, Ky., has passed into the hands of G. T. Carnal, of Vandersburg, Ky. Included are the Sebree roller mills, elevator, electric light plant and considerable real estate.

The Walloomsac Paper Company, North Adams, Mass., are installing an electric power and lighting system. Power will be secured from the Connecticut River Transmission Co. and the electrical apparatus will be installed by the General Electric Co.

Work has been begun on a new power plant to be situated on the Leicester side of the Genesee River and at the power dam across the stream. The project is under the direction of the Mount Morris Water Power Company and Engineer Cushing, of Rochester, has charge of the operations.

The Great Western Power Company has been granted permission to build and operate an electrical power house from Big Meadows to the Engels copper mine, and sell light and power generally in Plumas County, California. The new line will cost $40,000.

United States firms have furnished over 40 per cent. of the electrical machinery and supplies used in Brazil. There has been no special concentrated effort; thanks are due to the street railway and light and power systems in various cities under the management of Americans.

After nearly two years of construction work and the expenditure of nearly $100,000 in capital, the new high tension electric light and power line has been opened for Corry, Pa. The new substation is equipped with the most modern electrical appliances for the control of electric current.

The dam at the falls of the Missouri River, some fourteen miles from Great Falls, Mont., has been completed. The dam was built by the Montana Power Company, which will furnish power for the electrification of the Chicago, Milwaukee & St. Paul Railway. The cost was about 5 million dollars.

The Peninsula Telephone Company, of Tampa, Fla., is increasing its telephone system with new switchboard equipment. The plans call for most modern devices to assure high grade service. These cover the flashing, recall and automatic ringing and listening, incorporating the secret service feature.

The J. G. White Companies in their annual report issued during April last, says that new business, though not large, but in encouraging volume, has been arranged for. In the opinion of the officers the prospects seem better than they have been previous to the outbreak of European hostilities.

The Southeastern Section N. E. L. A. will hold its 1915 convention in Asheville, on September 22nd, 23rd and 24th. Elaborate entertainment features are a part of the program, besides the many valuable papers on modern practice to be presented.

An important deal was recently concluded when the control of the Beaver County Electric Company and Midland Electric Company was taken over by interests friendly to the Duquesne Light Company, of Pittsburgh. Improvements aggregating over $500,000 will be made on the equipment ofthe new company in the near future.

The Deerfield River Power Company has bought the property of the National Metal Edge Box Company, of Readsboro, Vt., which includes the paper and pulp mill situated there. The power company intends to develop 4,000 electric horsepower at the Readsboro plant and put in the electrical installation this fall.

The strike of Newark Local, International Brotherhood of Electrical Workers at the new power house being built by the Public Service Corporation has resulted in a victory for the strikers. The grievance rested in the fact that the organized electricians were compelled to work side by side with non-union employees.

American Power and Light Company subsidiaries now supply electric light and power service to 114 communities, artificial gas to fifteen communities, natural gas to four communities, water service to seven communities, street railway service to three communities and interurban railway service to three communities. The total population served is estimated at 970,000.

The Youngstown & Sharon Street Railway Company have signed $10,000 bonds for the work of installing a lighting system in East Youngstown and furnishing the current for lights. There are to be 169 hundred-candle power lights for the residence section and 129 ornamental white way standards for the business section.

The United States Court for the District of Maryland has issued an injunction against the Rowan Electric Manufacturing Company, restraining them from further infringement of Patent No. 1,135,870, owned by the Monitor Controller Company, of Baltimore, Maryland, for improvements in motor starters and granting the latter company an accounting.

The recently formed Hortonia Power Company, of Rutland, Vt., has completed plans for a consolidation with the Gaysville Electric Light and Power Co. The former will run a line from the present plant at Brandon over the Rochester Moustain to Gaysville, 28 miles distant, when connection will be made with the water power plant of the Gaysville company.

The system of electrical development of the power station of the Merrimac Valley Power and Building Co. at Amesbury, Mass., is being developed and when the new work is completed, about 1,000 horse power, approximately double the present capacity will be produced. This will be accomplished not by generating more power, but by use made by the present generator and water turbine.

All Byllesby electric properties reporting for the week ending August 12, showed connected load gains of 387 customers with 175 kilowatts lighting load and 639 horsepower in motors. New business contracted for included 1,037 customers with 509 kilowatts lighting load and 511 horsepower in motors. Output of the properties for the week was 9,000,273 kilowatt hours, an increase of 15.9 per cent. over corresponding week of 1914.

An extension of nearly seven miles of transmission line is being constructed by the El Reno Gas & Electric Company to serve the Indian Agency and El Reno Vitrified Brick Company. Other business along the right of way which will probably be secured includes light and power for Fort Reno, Rock Island Railway pumping load and a considerable amount of irrigation power and other business from the farmers.

The Metropolitan Engineering Company announces that is maintains a permanent exhibit at the American Museum of Safety, New York, which represents the progress made in the electrical art with especial regard to the safety service equipments that are installed by central stations. The museum is free to the public, there being no entrance charge of any nature.

The Galveston Gas company has been recently acquired by the Southwestern Power and Light Company, another subsidiary of the American Pawer Company. The Southwestern Power & Light Company and the Texas Power and Light Company have also acquired within a short time a number of electric light and power properties in Texas, and these are now being connected with existing transmission and distributing systems.

The Consumers Power Company, Minot, North Dakota, a Northern States Power Company subsidiary, is constructing an eight mile extension of its lines to serve the town of Burlington. Burlington is a thriving community and about fifty houses are being wired at the present time to be ready for service as soon as the line is completed, which will be in about fifteen days. Along the transmission line a number of farms will be connected for power and light.

The South Jetty at the entrance to Humboldt Bay has been completed and work has been started on the North Jetty. This work will take from two to three years. Rock used in the work is quarried by electric power furnished by the Western States Gas & Electric Company. The Eureka Brewery has secured a large contract which will necessitate construction of a new plant and increase the concern's electric power requirements.

The Illuminating Engineering Society will hold its 1915 convention at Washington, D. C., December 20th to 23rd inclusive. The program includes numerous papers of a technical nature, which promise to be of an unusually high standard. The reading of these is to be distributed over 10 sessions, one of the sessions will be devoted especially to the purpose of street lighting; commercial, general and laboratory papers will each be given three sessions. Inspection trips, a reception and banquet are among the entertaining features.

The new standards of outdoor illumination achieved in the lighting of the San Francisco Exposition are being striven for in the larger cities of the country, and it is probable that within a short time many beautiful buildings will be thrown into luminous relief by light rays from concealed sources. The Louisville Gas & Electric Company has just made arrangements to illuminate the front of the new Bernheim Building in this manner. Five projectors to be located on a roof across the street from the building will transmit the light from 500-watt type C mazda lamps. The agents for the building are to use this method of advertising to attract desirable office tenants.

With the completion to Temple, Texas, on Sept. 1 of the high-power, long-distance transmission line being built for the Texas Power and Light Company from Waco to Taylor, a number of rural communities and prosperous villages will be supplied with electric current for lighting and power purposes for the first time. Included in this number are Troy, Eddy, Bruceville and Lorena. South of Temple, Holland and Thrall, now without electric plants, will be taken care of by the new line. Local plants at Moody, McGregor and Thorndale have been taken over by the larger company and will be operated by it hereafter.

The upstate Public Service Commission will approve the modifications made in the new rate schedule filed by the Buffalo General Electric Co. and the Catract Power & Conduit Co. which was recenlty taken over by the Buffalo company. There was no opposition to the proposed schedule at a hearing and it will reduce rates slightly more than 19 per cent. provided for in the original order of the commission. The new schedule provides a gradual decrease of rates as consumption increases in place of the present "steps" and will be more easily understood by the consumers as it eliminates the more than a dozen elements which go to make up their bills under the present schedule of rates.

In Massachusetts there now exists a Board of Examiners for electricians' licenses, its jurisdiction having started Sept. 1, by virtue of a bill recently passed through the Legislature. Licenses are issued to the master or employing electricians and also to journeymen, these being identified respectively by Certificate A and Certificate B. Some of the points in this law are: it prohibits the master electrician from taking actual part in installation work; it does not apply to the wiring, installation or repair of elevators; it does not affect the private work of public service companies; municipal plants are also exempted for work up to the service switch. License certificates are subjct to renewal and provision is made for fines and imprisonment for violation of this act.

An agreement between the representatives of the bankers, bondholders and stockholders interested in the new financing plan for the "Metropolitan" of Kansas City, Mo., has been reached. The agreement provides ahat the Kansas City Electric Light Company shall assume 5 million dollars of the outstanding securities of the Kansas City Railway and Light Company, the New Jersey Holding Corporation; 3 million of first mortgage bonds and 2 million of second mortgage bonds.

This leaves $23,700,000 in outstanding debts to be charged to the street railway company. The new traction company is to issue new securities, which are to be exchanged pro rata with the bondholders of the holding corporation, which will cease to be.

The new securities necessary to take up those of the holding corporation will bond the Metropolitan up to its physical valuation, leaving little or no margin for further issues of securities.

Business Opportunities

NEW ENGLAND

Manchester, N. H.: A string of about eigth 600 candle power mazda lamps will be placed soon on Chestnut Street, extending from Merrimack. These will replace the arc lights now in use.

Melrose, Mass.: .Plans for the extension of the ornamental street lighting system on Main street, from Porter street to Franklin square, are being perfected by Mayor Adams and the public service committee of the board of aldermen.

..**Westfield, Mass.:** The town of Westfield is floating $25,000 4 per cent. coupon and electric bonds, dated August 15, 1915. The amount raised by the sale of these bonds will be used for improvements and extensions of the municipal light plant.

Southwick, Mass.: At a special town meeting held August 14, it was voted to acquire electric lights for the street and arrangements are being made with the Southwick Electric Light Co.

Ludlow, Mass.: It is thought likely that the Ludlow Electric Light Co. which has taken over the electric lighting of the town will extend its facilities for the transmission of electric power for manufacturing purposes by erecting a power station in Ludlow.

New London, Conn.: It is under stood that a new electric generating station and boiler plant for the Connecticut Power Co. in New London will shortly be constructed.

MIDDLE ATLANTIC

Little Falls, N. Y.: A special committee is studying pretty thoroughly the matter of equipment for the boulevard lights. The city is in the market for seventy-four ornamental poles to replace the wooden ones now in use in the business section of Main street.

Stony Brook, N. Y.: A petition of taxpayers for 150 electric lights has been granted and bids will be advertised equipping the new district.

Yonkers, N. Y.: The common council has passed an ordinance directing the erection of 92 additional ornamental lights on South Broadway. Twelve ornamental lights will probably be placed in Sherwood Park. The entire improvement will come to several thousand dollars; standards will be placed by contract; the rest of the work will be done by the Yonkers Light & Power Co.

Tonawanda, N. Y.: The city governmest has in preparation the specifications of a new lighting contract.

Far Rockaway, N. Y.: A strong agitation for the establishment of a lighting district between Woodmere and East Rockaway is under way. It is probable that enough pressure will be brought to bear to put the project through.

West Oneonta, N. Y.: The town board has taken favorable action upon a petition for a special lighting district at Oneonta Plains. A committee will confer with the Otsego & Herkimer R. R. Co. in reference to a contract for furnishing the lights.

Washington, D. C.: It is understood that President Wilson has definitely approved the project of developing Great Falls as an electric light and power project for the District of Columbia. The plans and specifications for the power plant have been drawn up.

Canastota, N. Y.: An appropriation of $1500 has been made for ornamental street lighting. There will be 18 steel posts, each carrying one light and the wires will be carried underground.

Newark, N. J.: The city of Newark has taken steps to replace a number of the old carbon arc lights with 600 candlepower nitrogen film lamps of the mazda type. The Board of Works authorities are contemplating further installations in the shape of 400 candlepower mazdas in the residential sections.

Caldwell, N. J.: According to Mayor Cook's first message, Caldwell intends to have a group of nitrogen lamps installed in its main thoroughfare.

Bayonne, N. J.: In response to a request of the Peninsula City Company, the city commissioners will erect some new electric lights in West Fifty-seventh street.

Millville, N. J.: Plans and specifications for a complete electric lighting system have been adopted and a resolution passed asking for bids for the construction of a new plant.

Hazelton, Pa.: Plans for ornamental street lights which the city has had under consideration have been approved and it is proposed that a number of posts will be erected.

New Brighton, Pa.: The Beaver County Light Co. of New Brighton and the Midland Electric Co. are planning to spend some $500,000 for new equipment. new management is in control.

Keyser, W. Va.: An addition to its machinery equipment is being considered by the Keyser Electric Light Co., according to a competent report.

NORTH CENTRAL

Monroe, Ind.: At a recent election the citizens of Monroe voted to install a electric lighting system.

Kankakee, Ill.: Mayor Alpine has announced that the matter of a more modern lighting system for the city is being taken up and that considerable changes will be made.

Galena, Ill.: The Interstate Light & Power Co. has notified its local manager of its intention to install additional equipment in its Galena plant, sometime within the next two months. Another turbine of 3500 h. p. capacity will be added. Additional boiler capacity, pumps, and improvements to the automatic stokers are on the list; also improved, efficient apparatus will be installed.

Merrill, Wis.: The Committee appointed to investigate the matter of street lighting reported that the system was inadequate and inefficient and advocated a thorough going modernization thereof.

Lawrence, Kans.: There is a strong movement afoot in Lawrence to adopt the plan for the white way lights which has been submitted to the city board of commissioners.

Hallock, Minn.: It is probable that arrangements will be made to install an electric lighting system in Hallock during the coming fall.

Fairfield, Idaho: Estimates are being prepared with the end in view of erecting an electric power and light plant for Fairfield.

Rochester, Minn.: The utility board of the city of Rochester has been authorized by the common council to construct a new municipal electric plant to cost about $125.000. The Charles L. Pillsbury Engineering Co., Minneapolis, are to be the engineers in charge.

SOUTH

Indian Springs, Ga.: The Misses Scoville, present lessees of the Wigwam Hotel at Indian Springs, are intending to make their own power and lights for the hotel, using power generated by a nearby stream. Estimates on the project are now being prepared.

Raleigh, N. C.: Arrangements are being made to install a "White Way" system on eleven blocks in the business district and the city will, i nthe near future, be in the market for seventy or eighty single light standards for magnetite arcs. Col. Jos. E. Pogue, as chairman of the committee, or N. L. Walker as engineer, may be addressed.

La Grange, N. C.: A new power house in which is to be installed a 75 h. p. Samson water turbine is being built by H. H. Sutton & Co. Before the middle of September they will probably be in the market for either a first or second hand 37 K.W. to 50 kw. generator and an oil engine from 50 to 75 h. p

Southport, N. C.: The Southport Light and Power Co. are planning to install an 80 h. p. crude oil engine. They will also be in the market for 4000 feet of No. 8 double braided wire, two 20 kw. transformers and one 15 kw. transformer. Later the company expects to purchase a new switchboard.

Apex, N. C.: The Municipal Service Corporation has been granted a franchise to construct and operate an electric lighting plant, waterworks and sewerage . The cost of the work will be about $40,000.

..**Marshall, Okla.:** The town of Marshall has voted $25,000 of bonds to finance a municipal electric light and power plant.

Shawnee, Okla.: The Shawnee Gas & Electric Co. will be in the market within the next two months for 130 high-efficiency series alternating-current street lamps of 400 c. p.

Tulsa, Okla.: Bids will close September 27 for the construction, and mechanical equipment of the United States post office and court house at Tulsa. Plans and specifications may be seen either at the office of the supervising architect, treasury department, Washington D. C., or at Tulsa.

Dallas, Texas: Work will be begun in a short time on an interlocking plant to cost $200,000, which is to be built in connection with the new railroad terminal and union station.

San Angelo, Texas: The San Angelo Water, Light & Power Co. is planning to invest $50,000 in additional machinery.

Georgia Electrical Contractors Hold Meeting

The Georgia Electrical Contractors' Association was organized in April, 1914 and since that time they have held periodical meetings in different parts of the State, for the purpose of completing their organization.

They have done much towards strengthening their relations with each other, as well as with the jobbers.

The last meeting was held at St. Simons Island on Monday, August 23rd. This meeting was called for the purpose of hearing a report from Mr. T. H. McKinney, who represented the Georgia Contractors at the National Electrical Contractors' Convention held at San Francisco in July.

Mr. McKinney's report gave a detailed account of the transactions of the convention, including many new ideas regarding the development of the electrical industry and trade in the West. Other matters of a local nature were taken up in the business session.

A special car left Atlanta Sunday night, carrying contractors and guests from Atlanta and Athens, who were joined at Macon by representative contractors from that city.

The party reached Brunswick Monday morning, and after a hasty breakfast, boarded the boat for St. Simons, reaching the Island at 10 A. M. There they were received by othe members and friends of the Association, who had preceded them to the Island at 10 A. M. There they were received by other members

The following attended the meeting:

CONTRACTORS

T. H. McKinney—T. H. McKinney, Inc., Atlanta, Ga.
J. M. Clayton—J. M. Clayton, Atlanta, Ga.
J. F. Bryan—Bryan Electric Co., Atlanta, Ga..
Carroll McGaughey—McGaughey Elec. Co., Atlanta, Ga.
Hunter Hogue—Hunter Hogue Electric Co., Atlanta, Ga.
W. C. Greene—Gate City Electric Co., Atlanta, Ga.
E. D. Peters—E. D. Peters Elec. Co., Atlanta, Ga.
Joe Little—Russell Electric Co., Atlanta, Ga.
S. D. Woodward—Woodward Electric Co., Atlanta, Ga.
Wm. Bailey—Bailey Electric Co., Atlanta, Ga.
Joel Wier—Athens Engineering Co., Athens, Ga.
H. E. Lowe—Lowe Electric Co., Macon, Ga.
Morris Putzell—Morris Putzell, Macon, Ga.
Chas. Ludwig—C. F. Ludwig Co., Dublin, Ga.

H. J. Von Weller—Electric Service Co., Albany, Ga.
Norton Frierson—Norton Frierson, Savannah, Ga.
F. J. Frei—Sandiford, Cramer & Frei—Savannah, Ga.
Mr. Marill—J-M. Electric Co., Savannah, Ga.
A. M. Calder—A. M. Calder, Brunswick, Ga.

JOBBERS AND DEALERS

P. C. Gilham—Carter Electric Company, Atlanta, Ga.
T. A. Burke—Western Electric Company, Atlanta, Ga.
J. J. Smith—Baltimore Electrical Sup. Co., Atlanta, Ga.
M. O. Hutchinson—Fulton Electric Company, Atlanta, Ga.
H. T. Stanton—Western Electric Company, Savannah, Ga.

MANUFACTURERS

Chas. D. Wayre—Benjamin Elec. Mfg. Co., New York.
G. M. Stout—National Metal Moulding Co., Atlanta, Ga.

The entertainment for the meeting was furnished by Messrs A. M. Calder, Brunswick; Chas. Ludwig, Dublin and H. J. Von Weller, Albany.

Most of the day was devoted to business which was undisturbed except for occasional snores eminating from the corner of the porch where the manufacturer's representatives were sweetly sleeping in an effort to forget the events of the night before.

Late in the afternoon the youthful members of the party enjoyed a swim in the surf. This pleasure was uneventful except for the fact that a shark escaped with the seat of Hunter Hogues' bathing suit, and a crab chased Morris Putzell across the beach, who, loaded down with his moving picture machine, was saved only by the appearance of Tom Burke, whose crustaceous appetite will put any wise crab to light.

The return trip to Brunswick under the guidance of the bright and inspiring moon, was featured by frequent outbursts of harmony in which all joined, following alternately the "fog horn" bass of Pat Gilham and the "siren" tenor of Tom McKinney.

Brunswick was reached just in time for Joe Bryan to buy a new hat (nobody but Joe knows what became of his old one) and for everybody to board trains for their respective destinations.

The next meeting will be held at Macon, Ga., in January.

ELECTRICAL AGE

THE NATIONAL JOURNAL OF
Electric Practice
Formerly ELECTRICAL ENGINEERING
Issued Monthly by Technical Journal Co., Inc.
1642 Woolworth Bldg., New York
Chas. B. Thompson, President
Wm. F. Eastman, Vice Pres.
SOUTHERN OFFICE, GRANT BLDG., ATLANTA, GA. CHICAGO OFFICE, 651 MARQUETTE BLDG.
Telephones: New York, Barclay 7448; Chicago, Central 3792

Volume 47 OCTOBER, 1915 Number 10

CONTENTS

SUBSCRIPTION PRICE—United States and Possessions, Mexico and Cuba $1.00 a year. Canada $1.50 a year. Foreign Countries in Postal Union $2.00.

CAUTION—Do not pay solicitors, unless they present *written authority*, with date, from the publishers to collect money.

NOTICE TO ADVERTISERS—To insure insertion, all copy, cuts, etc., for changes of regular advertisements in ELECTRICAL AGE should reach us NOT LATER than the 15th OF THE MONTH preceding date of publication; three days earlier if proof is desired. The first advertising forms close promptly on this date.

NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 20th.

Recognized Organ of the Southern Trade. *Member Audit Bureau of Circulation.*

Entered at the New York Post Office as Second-class Mail Matter.

This Issue, 10,000 Copies

ELECTRICAL AGE

THE NATIONAL JOURNAL OF

Electric Practice

Formerly ELECTRICAL ENGINEERING

Technical Journal Company, Inc., New York

Vol. 47 OCTOBER, 1915 No. 10

Operating and Control Features of an Hydroelectric Plant

Considering the Electrical Equipment of the Parr Shoals Hydroelectric Development on the Broad River, South Carolina

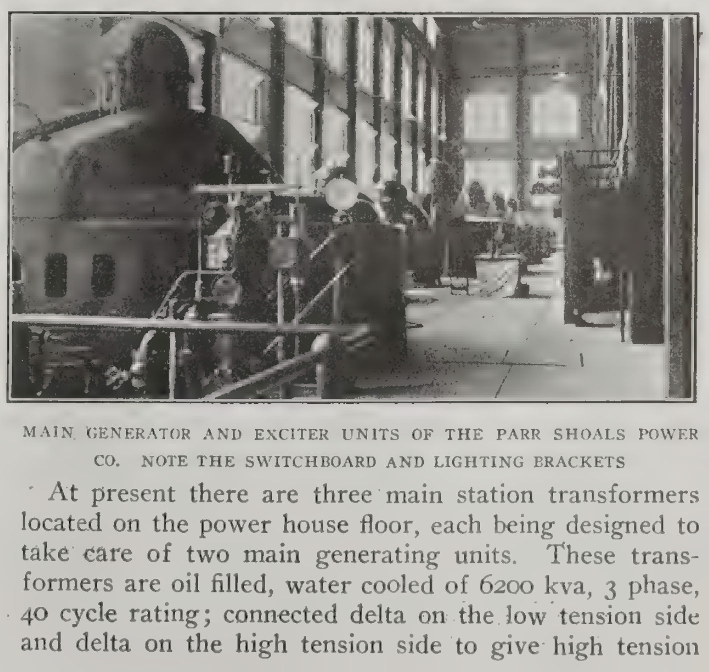
FOLLOWING up the hydraulic end of this development, the electrical features will now be considered. In the plan view of the power house may be seen that the various machinery is distributed over the main floor and in part on the gallery running the length of the building.

There are now five a.c. main generating units direct connected to water wheels, each rated at 3100 kva at 75 per cent. power factor. These are 40 cycle, 3 phase, 2300 volt machines with 48 poles, giving 777amp per terminal at 100 r.p.m. They are of vertical shaft, revolving field type, each with a roller thrust bearing on top to take the weight of the revolving field, shaft and turbine runner.

The hydraulic turbines, direct-connected to the dynamos, each deliver 3600 horse power at 100 r.p.m. and an effective head of 35 ft. They are of the vertical shaft, single runner, downward discharge type being set in a spiral concrete casing and discharging into a concrete draft tube. Part of the main governor equipment includes a relay compensating device and synchronizing attachment for switchboard control.

The compensating relay operates on the double floating lever principle, allowing great stability of speed regulaand racing are entirely eliminated. The rates of speed variation between no load and full load can be adjusted from 6 per cent. to as small as is required for commercial operation. The synchronizing attachment consists of a d.c. motor controlled from the switchboard, the motor operating the floating lever by means of a belt and gear connection.

The exciting current required when the generators deliver 777 amp at 2300 volts and 100 per cent. power factor is 360 amp and when running at 75 per cent. power factor with the other conditions alike, the field current is guaranteed to be no more than 450 amp. Since field excitation is at 125 volts each generator requires 60 kw in exciter capacity. There are two exciter units for this purpose, each rated at 300 kw at 125 volts when operating at 300 r.p.m. These machines are driven by hydraulic turbines of the vertical shaft pattern with single cast iron runners, delivering 425 hp when operating under a head of 35 ft. at the rated speed of 300 r.p.m. The generator end of each exciter unit is compound wound for Tirrill regulator operation and is capable of handling the five main alternators.



MAIN GENERATOR AND EXCITER UNITS OF THE PARR SHOALS POWER CO. NOTE THE SWITCHBOARD AND LIGHTING BRACKETS

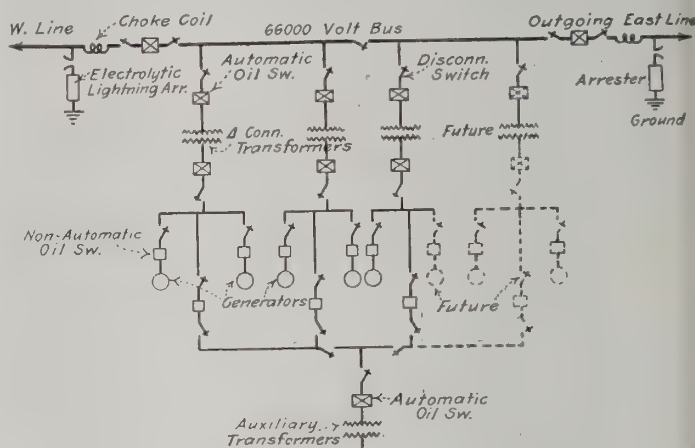
At present there are three main station transformers located on the power house floor, each being designed to take care of two main generating units. These transformers are oil filled, water cooled of 6200 kva, 3 phase, 40 cycle rating; connected delta on the low tension side and delta on the high tension side to give high tension

voltages of 66000—64000—62000 and 60000 with 2300 volts on the low tension, giving full capacity at any of these pressures. These transformers are cylindrical in shape with a casing of boiler iron, riveted and caulked. They are 8 ft.-6 in. in diameter and 11 ft.-1 in. high, weighing 92000 lbs. when assembled, the tanks each requiring 3500 gals. of oil.

Main Control

As shown on the accompanying plan, the switchboard is located between the exciters and the up-stream side of the power house; the transformers are placed near the up-stream wall with the low tension bus structure which includes the switches for each group of two alternators and one transformer. The high tension transformer and line switches are located in the gallery above the transformers proper with suitable openings provided for the high tension leads, the arrangement being clearly indicated in the sectional view herewith.

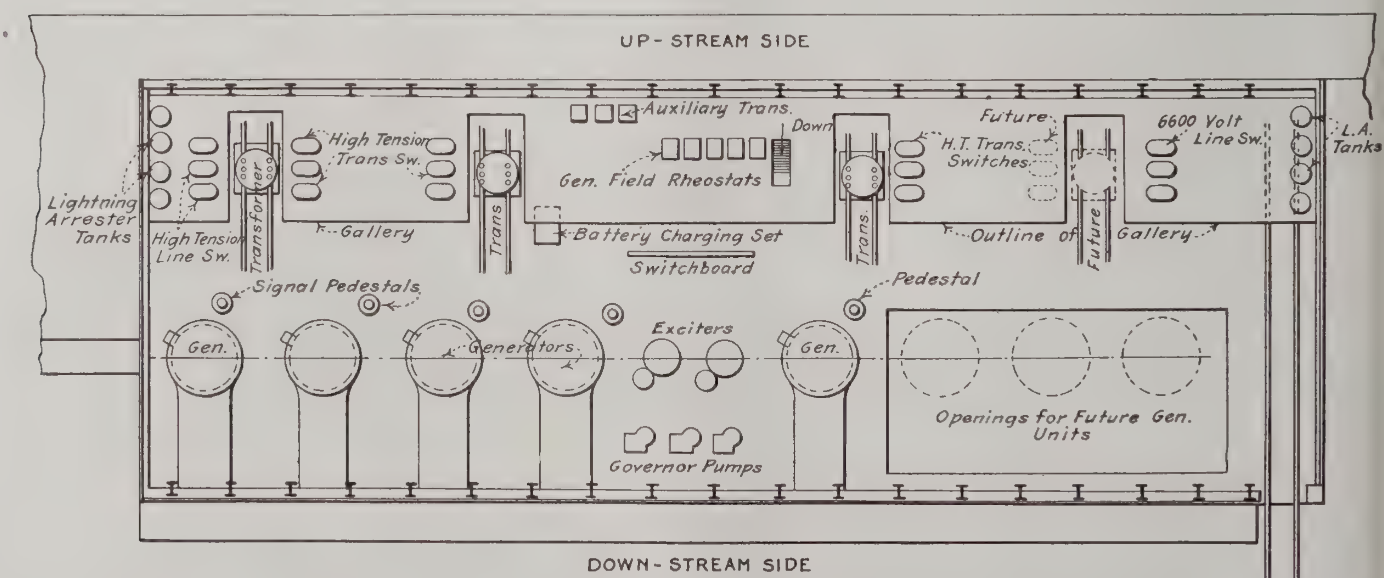
The low tension buses and low tension switches are mounted in a brick structure. The high tension buses are $\frac{3}{4}$-in. copper rods supported from the roof steel by 66000 volt pin type insulators. The high tension bus has a sectionalizing switch between the second and third transformers, so that the station can be operated in two halves on the high tension side. At each end of the building is a high tension line switch with disconnecting switches on both sides of the oil switch and with choke coils for the outgoing lines, which leave through 66000 volt roof bushings as shown. The lightning arresters provided for each line are mounted indoors with the horn gaps outside but are controlled from the inside by operating rods. The leads to the lightning arrester tanks from the lines enter the building through roof bushings at one end and then wall bushings at the other end. The disconnecting switches on the bus side of the transformer high tension oil switches as well as the disconnecting switches on each side of each line switch are of a special type vertically mounted. These special disconnecting switches consist of a brass rod clamped rigidly on an insulator which is mounted on a movable I-beam, the rod having a contact at each end. These contacts fit into jaws on insulators mounted above and below. There is one rod and one set of contacts mounted for each phase. The insulators holding the rod section of the switch are all three mounted on the same movable I-beam so that all three poles of the switch operate at the same time.



PARR SHOALS DEVELOPMENT.—SINGLE LINE DIAGRAM SHOWING THE MAIN ELECTRICAL LAYOUT AND CONTROL FEATURES OF THE GENERATING STATION.

In the case of the disconnecting switches on each side of the line oil switches, the switches on each side of an oil switch operate in pairs. The movable I-beam is operated by a chain and gear and is counter-balanced for easy operation. The high tension bus can be sectionalized by means of knife blade disconnects mounted between the second and third transformers.

The low tension buses are arranged in groups as shown in the diagram of the electrical layout. One group takes care of two generators and can be connected to the corresponding transformer for the two generators or can be connected to a back bus. This back or transfer bus will enable any transformer to be used with the other generators or if the transformer is inoperative, the generators can feed through the other transformers by means of the back bus, resulting in a very flexible operating arrangement. The back bus also feeds the station auxiliary transformers. The taps to these small trans-

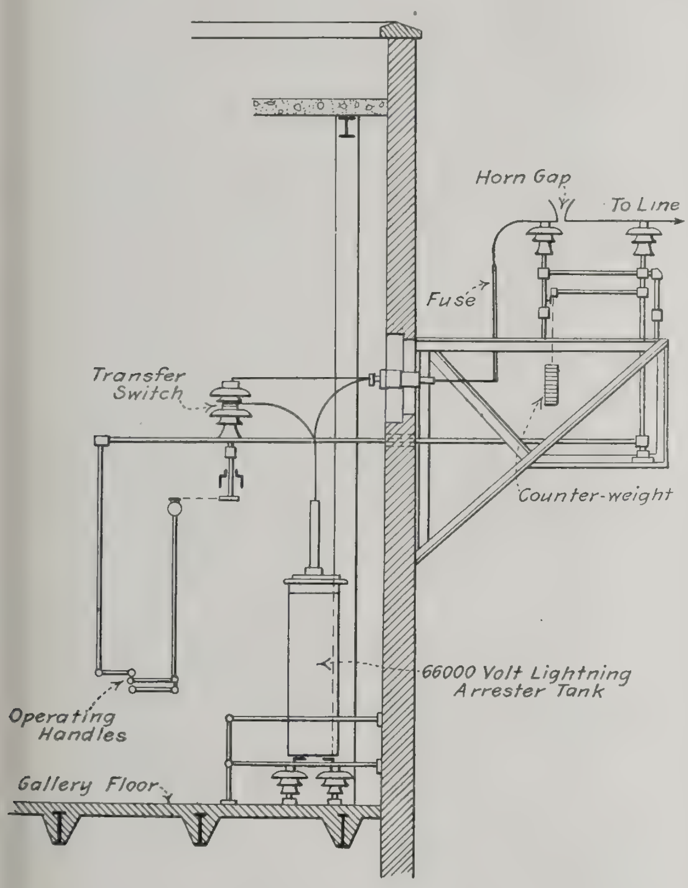


PARR SHOALS DEVELOPMENT.—PLAN OF THE POWER HOUSE, 51 FT. BY 300 FT. DESIGNED FOR AN ULTIMATE INSTALLATION OF EIGHT MAIN GENERATING UNITS. THE UP-STREAM WALL OF THIS BUILDING IS FORMED BY THE DAM. BUS AND LOW TENSION SWITCH STRUCTURES, BENEATH GALLERY.

formers are taken between the second and third main transformers.

On each side of the point where these transformers are tapped, disconnecting switches are installed in the back bus so that the station auxiliaries can be fed from either half and at the same time the station can be cut in half on the low tension side, in fact the station can be operated in two halves at different voltages feeding out over the separate lines to the substation.

The cables from the generators run through fiber conduit laid in the concrete floor going direct to the generator oil switches then through disconnecting switches to the group bus. This group bus is made up of copper bars and is mounted in the brick bus structure. From



PARR SHOALS DEVELOPMENT.—ARRANGEMENT OF 66,000-VOLT LIGHTNING ARRESTER TANKS, WITH HORN GAPS OUTSIDE OF BUILDING BUT CONTROLLED INDOORS BY OPERATING RODS. DETAIL SHOWS INSTALLATION ON THE EAST OUTGOING LINE.

the group bus the lines go through a set of disconnecting switches to the transformer low tension oil switches, and then to the low tension side of the transformers. The leads to the low tension side of the transformers are of copper bars.

From the group bus another set of leads go through disconnecting switches, an oil switch, through another set of disconnecting switches to the transfer bus grouped for each pair of generators with the corresponding transformer. From the high tension side of the transformers, the leads go to the transformer high tension oil switches through a set of disconnecting switches to the high tension bus.

The generator main leads each consist of two 500,000 cir. mil lead covered cable, in separate fiber ducts. The bus leads and leads to the low tension side of the transformers are bare copper bars wrapped with varnished cambric tape after installation. The leads from the high tension bus are of ½-in. iron-pipe size copper tubing.

The generator oil switches are each type E 6600 volt, 1200 amp, 3-pole, single throw non-automatic oil switches of Westinghouse make supplied with a special device which holds all three single pole elements rigidly together for simultaneous operation of the three phases. The tie switch between each group bus and the transfer bus is type E-2000 amp, 9000 volt non-automatic breaker same as the above, with the three elements rigidly connected. The low tension transformer switches are of 2000 amp capacity 15000 volt, 3-pole single throw type C automatic breakers.

The high tension transformer switches are 200 amp 66000 volt automatic G.A. breakers, 3-pole single throw, each being provided with bushing type double secondary current transformers. The outgoing line switches are 300 amp 66000 volt, 3-pole single throw automatic solenoid operated type G.A. circuit breakers with double secondary current transformers, bushing type. The station auxiliary transformers which are fed from the 2300 volt transfer bus are operated through a 300 amp 15000 volt, 3-pole single throw automatic type C oil circuit breaker. All circuit breakers are solenoid operated remote control.

Operating Characteristics

The generators are excited from the two 300 kw water wheel exciter-units, the leads from which go direct to the switchboard pit. These are run in 3-in. fiber conduit and consist of three 1,500,000 circ. mil cables for each equalizer lead. On each exciter panel there are two double throw single pole knife switches for the negative and equalizer leads and a single pole single throw knife switch for the positive leads. These switches are each of 2400 amp capacity. On the back of the board are two sets of equalizer buses, each made up of two negative and one positive bus. The negative and equalizer leads go direct through the knife switches to the buses while the positive lead goes through the knife switch and then through a 3000 amp single pole carbon break circuit breaker equipped with reverse current relay but is non-automatic on overload.

MAIN SWITCHBOARD OF THE PARR SHOALS POWER CO.

From the positive exciter bus, the exciting current goes to the main generator field switch —one mounted on each panel— and then to the field. From the negative buses at the board the leads are taken to a negative

switch panel from which the leads are run to the main generator field rheostats and to one side of the main generator fields. By this scheme the exciters can be operated separately and any generator can be excited from either bus. The generator field leads are of 750,000 circ. mils run in fiber ducts.

The exciters are guaranteed to produce 300 kw at 125 volts and 300 r. p. m. for 24 hours with a temperature rise of commutator not to exceed 55° C. and no other part to rise more than 50° C. above the surrounding air. The load can be increased 25 per cent. momentarily without sparking at the brushes or requiring shifting of the brushes.

Load	Main Generators	Exciter Units	Transformers
¼	85.7%	83.0%	96.5%
½	91.7%	90.0%	97.8%
¾	93.4%	92.4%	98.1%
Full	93.8%	93.4%	98.2%

Parr Shoals Development.—Table of guaranteed efficiencies on main equipment. In order to be certain that the above figures could be actually met, complete tests were conducted at the factory with entirely satisfactory results.

The voltage regulation of the exciters by the compound winding is at no load, 125 volts when operating at 310 r. p. m. and at full load the voltage is 125 at 300 r. p. m. The guaranteed efficiencies met under test are as given in the tabulation.

The regulation of the generators is guaranteed as follows: At constant speed and excitation, 581 amp per terminal at 100 per cent. power factor, can be thrown off with a voltage rise of 8 per cent. At constant speed and excitation, 777 amperes at 75 per cent. power factor, can be thrown off and voltage will rise 29 per cent.

The efficiencies of the generators as given in the tabulation are based on the copper and iron losses and windage and friction losses. Full load is 2325 kw at 75 per cent. power factor or 3100 kva at 75 per cent. with 2300 volts and 777 amp.

The generators will operate continuously for 24 hours with an increase in temperature not exceeding 50° C. The generator fields were tested by applying 1500 volts between field windings and cores for one minute and the armatures were tested by applying 5000 volts for one minute.

The transformers are guaranteed to carry their rated capacity continuously with a temperature rise not to exceed 50° C. above the temperature of the water used for cooling, this being measured by thermometers or by increase of resistance. The cooling water required for each transformer is 24 gallons per minute. In considering the efficiency guarantees, the iron and copper losses are taken at 60° C. The results met are as shown in the tabulation.

The transformer tanks are mounted on a cast iron base. The cover is supplied with a relief valve to open in case of abnormal rise of pressure inside the tank. Each transformer also has a quick opening oil valve so that the tanks can be drained quickly. Each tank is supplied with a 1-in. pipe connection for sampling oil, is also equipped with gauge glasses and thermometers and alarm attachment which operates when the temperature of the oil reaches 70° C. The water cooling coils are of brass, tested to 250 lbs. per square inch before installation.

The cooling water for the transformers is supplied from a concrete cooling basin with spray nozzles, located on a hill above the power house. The water flows from the cooling basin to the transformer cooling coils, to the pumps in the station and forced to the nozzles in the cooling pond. The water in being sprayed is cooled by the atmosphere and thus the same water is utilized. Due to losses some make-up water is required and this is supplied from a storage tank on the hill.

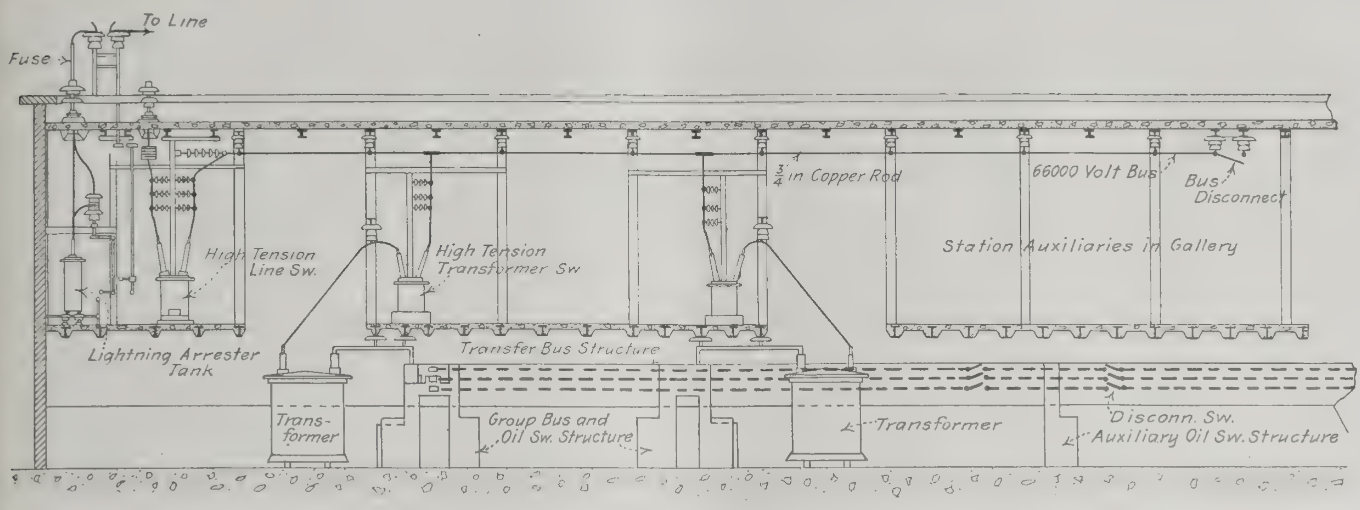
The control apparatus is normally operated from a storage battery installed in the gallery but the operating buses can be run from the exciters. This battery consists of 55 cells having a normal discharge rate of 20 amp for 8 hr. The charging generator which is driven by an induction motor is located on the main floor. The set consists of a 3 phase, 40 cycle, 1200 r.p.m., 220 volt motor and a d.c. shunt wound generator of 5 kw at 125 volts.

Wiring Installation

Where possible all power and control wiring is installed in fiber conduit laid in the concrete floor. The size of cables installed is based on the figures of current capacity as listed in the table shown herein. For 60 cycle service 750,000 circ. mil cable or larger should not be used except under special circumstances and for 25 cycle service 1,250,000 circ. mil cable or larger should not be used except under special circumstances. In either case rope center in the cable should be resorted to.

Wire Size	Amperes Capacity	
	Style A	Style B
8 B. & S. G.	24	33
6 "	36	46
4 "	56	62
2 "	84	93
1 "	102	112
0 "	124	136
00 "	150	165
000 "	177	195
0000 "	210	231
Circ. Mils.		
250000	240	264
300000	270	297
400000	330	363
500000	390	429
600000	450	495
750000	530	583
1000000	650	715
1250000	750	825
1500000	860	946
2000000	1050	1105

Parr Shoals Development.—Table of wire sizes. The cables used in this work were selected from the figures here shown. The current carrying capacity under style A is for single and multiple wire or cable with rubber, cloth, and paper iusulation when installed in conduit. Under style B are given the capacities allowed for open cables; these ratings correspond to an overload for two hours.



PARR SHOALS DEVELOPMENT.—SECTIONAL VIEW OF WEST HALF OF POWER HOUSE SHOWING THE HIGH TENSION AND LOW TENSION BUSES, THE OIL SWITCHES, TRANSFORMERS AND ONE OUTGOING LINE. NOTE THE DISPOSITION OF THE EQUIPMENT ON MAIN FLOOR AND GALLERY. THE EAST SECTION OF THE STATION IS SIMILARLY ARRANGED, THE PLANT LAYOUT BEING SYMMETRICAL WITH RESPECT TO ITS CENTER LINE.

Station Lighting and Signal System

The auxiliary power apparatus consists of several small motors which are fed from the step down transformers located in the gallery.

The lighting is 110 volt from the transformers but can also be thrown on the d.c. exciter buses by means of switches on the a.c. auxiliary panel. These switches control the circuits in the two lighting panel-boxes from which are taken the branch circuits. Tungsten lamps with enameled reflectors on ornamental pipe brackets are used for general lighting. The switchboard panel contains four control switches. The emergency lighting provides for lights over the switch-board, in the generator pits and exciter pits. These lights are normally operated on the station auxiliary a.c. 110 volt lighting buses but in case of the loss of voltage a no-voltage relay throws these lights over to the battery circuit. The small transformers for the station auxiliary supply are five in number, each of 15 kva capacity; two for lighting and three for motors.

The signal equipment as provided for each generator and exciter consists of six indicating lights at the pedestal and on the corresponding switchboard panel with six, three point push button switches, and an additional two point button on each generator and exciter panel.

When the switchboard operator wishes to signal the machine man, he presses the two point button. This shows a signal above the switchboard giving the number of the generator on which the operation is to be performed. When the machine operator reaches the generator, the switchboard operator presses the button to show the desired operation on the machine, resulting in the lighting of a sign at the pedestal showing "Stand by"—"Shift load"—"Shut down"—"O. K."—"Full Speed"—or "Start." When the operation is completed by the machine man, he presses the corresponding three point button which shows the signal on the switchboard, indicating that the operation is completed. This system is necessitated by the length of the power house and the distance from the switchboard to the machine operator.

Transmission and Telephone Lines

The two lines run from the steel supporting framework on the power house to the steel line-towers. This line extends 26 miles direct to Columbia, on a 100 ft. private right of way. It is run on standard double circuit steel towers each carrying two circuits of number 2/0 B. & S. gage 19 strand conductors with a 5/16-in. stranded copper clad steel ground wire on top of the towers The wires of each circuit are in a vertical plane. Where the line enters the city of Columbia and runs along the bank of the canal, special small base towers are used. Two hundred and sixty towers were used with an average spacing of 528 ft., each tower being 50 feet to the lowest crossarm. The line insulators are with four discs in suspension and five used in strain.

A private telephone line mainly on wood poles, is run from the Parr Shoals station to the Columbia substation and in the city of Columbia the line is carried on the transmission towers. This line is of copper-clad steel wire, 0.42-in. in diameter.

The line is provided with three patrol stations so that in case of trouble the patrolman can communicate with the station. The telephone equipment at the station provides for an instrument in the office and one at the sluice gates as well as a four-party line to the operators' houses.

The line is arranged so that the operators' houses can call each other without communicating with the power house. This is done by bridging the bells at the houses across the line and connecting one side of the switchboard drop to the ground. A push button switch is mounted at each of the house phones and it is necessary to press the button when turning the generator crank in order to call the switchboard at the power house. Pressing the button grounds one side of the ringing generator so that the circuit is completed through the switchboard drop. The diagram shows this telephone layout.

Switchboard Equipment

The switchboard for controlling the station and for showing power output is of natural black slate with oil finish. There are fifteen main panels 90 in. high, with three panels for relays and wattmeters. The three relay and wattmeter panels are mounted away from the main switchboard. The meters are all standard black marine finish.

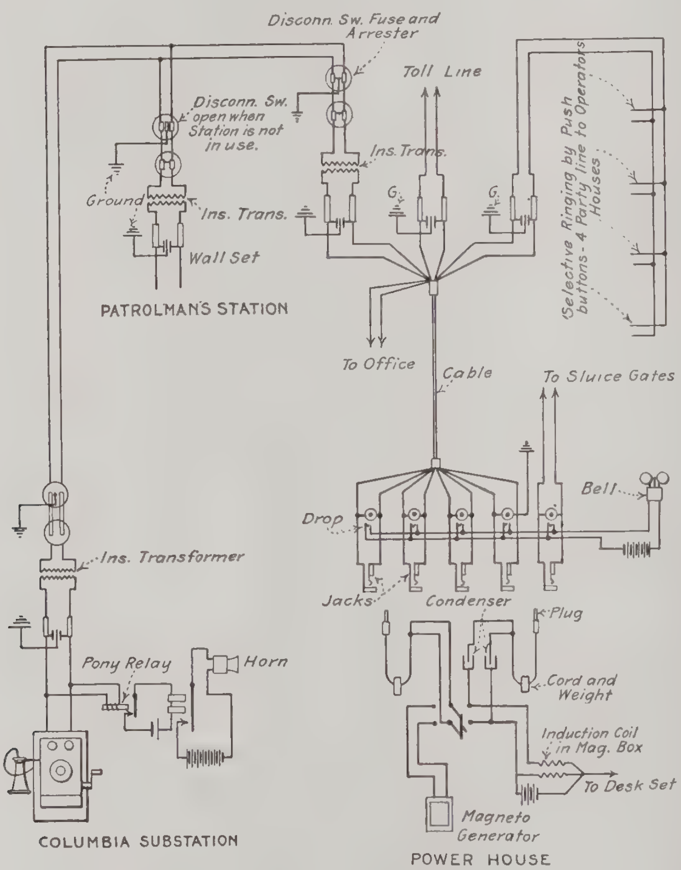
The main switchboard is equipped with a mimic bus showing the condition of the station at any time so that the operator can see at a glance what switches are open or closed.

The panels are arranged as follows, counting from the left facing the switchboard:

Swinging bracket containing: 2-150 volt d. c. voltmeters for exciters, d.c. bus and battery voltages; 1-3000 volt a. c. meter for reading bus voltages.

Panel 1 contains: Tirrill Regulator with handwheel for operating regulating rheostat at back; regulator type T. A. 125, form K-20 with regulating rheostat for 15 per cent. variation in voltage.

Panel 2 for storage battery and charging set: 1 triple-pole double throw switch for starting induction motor of charging set. Motor starts from full voltage, fused only on running side; 1-3 pole single throw battery switch; 2 single pole, double throw switches for throwing operating d. c. control buses on full battery, charging generator or part battery during overcharge and for throwing charging generator on battery or for operating control buses from charging generator without battery; 2 ammeters—one with zero center to show charging and discharging of battery; carbon break circuit breakers with reverse current relay trips; back of panel has alarm bell relay.



Parr Shoals Development.—wiring diagram of the telephone system between the power house and sub-station and operators' houses, arranged for use of patrolmen in case of trouble along the line.

Panel 3 for d.c. auxiliaries: 1-600 amp carbon contact circuit breaker; 1-600 amp meter; 1-single pole, single throw switch and 1 single pole double throw switch for throwing d. c. auxiliary circuit on either set of exciter buses.

Panels 4, 5 *and* 6, for exciters. Panel 4 is blank, provided for future motor driven exciter. Other each have: 1-4000 amp d.c. meter; 1-300 amp single pole type C. A. reverse current carbon break, circuit breaker, is non-automatic on overload; 1-type D reverse current relay; 2-2400 amp single pole, double throw knife switches; 1-2400 amp single pole, single throw knife switch for throwing exciters on either set of buses; 1-drum type governor controller for exciter turbine; 6-3 point push button switches; 1-2 point push button switch; 6-signal lamps; four-point plug receptacles for reading exciter voltages. Push buttons are for signalling operator and connect to pedestals near machines. Operating handwheel for field rheostats mounted on the panels. Also, panel 5 contains plug receptacles for reading d.c. bus voltages and panel 6 contains rheostat for equalizing load on the two exciters when in parallel on the Tirrill Regulator.

Panel 7 for a. c. auxiliaries: Drum type controller for 300 amp 15000 volt 3-pole single throw automatic type C oil circuit breaker operated by current transformer. This oil switch is in the circuit controlling the 2300 volt station auxiliary transformers for light, and small motors; 4-double pole, double throw knife switches for 125 volt station auxiliary circuits so connected that the circuits can be fed from the 110 volt side of the station auxiliary transformers or from the 125 volt d.c. buses fed from the exciter; 2-double pole, double throw knife switches connected so that the d.c. operating buses for solenoid control and switchboard indicating lamps can be connected to the battery or to either exciter bus.

Panels 8, 10, 11, 13 *and* 14 for main generators: 1-600 ampere d. c. field ammeter; 1-single pole, single throw knife switch for generator field circuit with discharge resistance; 1-4000 kw indicating wattmeter; 1-wattless component indicator; 1-1000 amp a. c. meter; 1-field rheostat switch for motor operated rheostat; 1-governor control switch for water wheel, used in synchronizing and load variation; 1-drum type oil switch controller for generator oil switch; 1-synchronizing plug receptacle with contact through which the closing circuit of the generator oil switch is wired, oil switch cannot then be closed until plug is inserted; 1-8 point potential receptacle for reading voltage on 3 phases of generator; 6-3 point push button switches for signal pedestals.

Panels 9, 12 *and* 15, each controlling main transformers: 3-2000 amp a. c. meters to read current in three phases of transformers; 1-4 point potential receptacle for transformers when synchronizing; 1-synchronizing plug receptacle, rotary type with auxiliary contacts for closing circuit of oil switch in transformer low tension circuit; 3-drum type oil circuit breaker controllers for low tension switch, switch between group bus and main transfer bus and high tension transformer. Panels 9 and 15 also contain drum type oil switch controllers for type G. A. high tension line oil switches.

Swinging bracket at right end of panel 15 contains: 2-3000 amp voltmeters, one reading bus voltage and the other generator phase voltage or transformer voltage for synchronizing; 1-type T. I. synchroscope; 1-frequency meter.

Panel A contains: Graphic voltmeter showing voltage on the station auxiliary bus; a wattmeter reading power to auxiliary bus; 2 relays operating type C oil circuit breakers controlling auxiliary circuitts.

Panel B contains: Watt-hour meters for 4 main generators; relays for outgoing line and for 2 transformers.

Panel C contains: Watt-hour meter for one main generator; relay for outgoing line and for one transformer.

Rural Distribution.—In some communities the farmers are taking current from the nearest transmission line at one point and retailing it among themselves. In other communities individuals find it desirable to pay for new lines. The electric company installs the connection and requires yearly minimum use proportionate to the investment in line extension.

EDITORIAL

ELECTRICAL AGE

IN KEEPING with the purpose of the publishers to make this publication a national journal of electric practice, the name has been changed to ELECTRICAL AGE, in order to convey more accurately the general field and scope of the paper.

As our readers have already noticed, ELECTRICAL AGE, in its present form, has special departments covering various branches of the industry, and with the continued co-operation of the trade, we hope to give our readers a big national monthly, covering all that is vital and interesting in the electrical field.

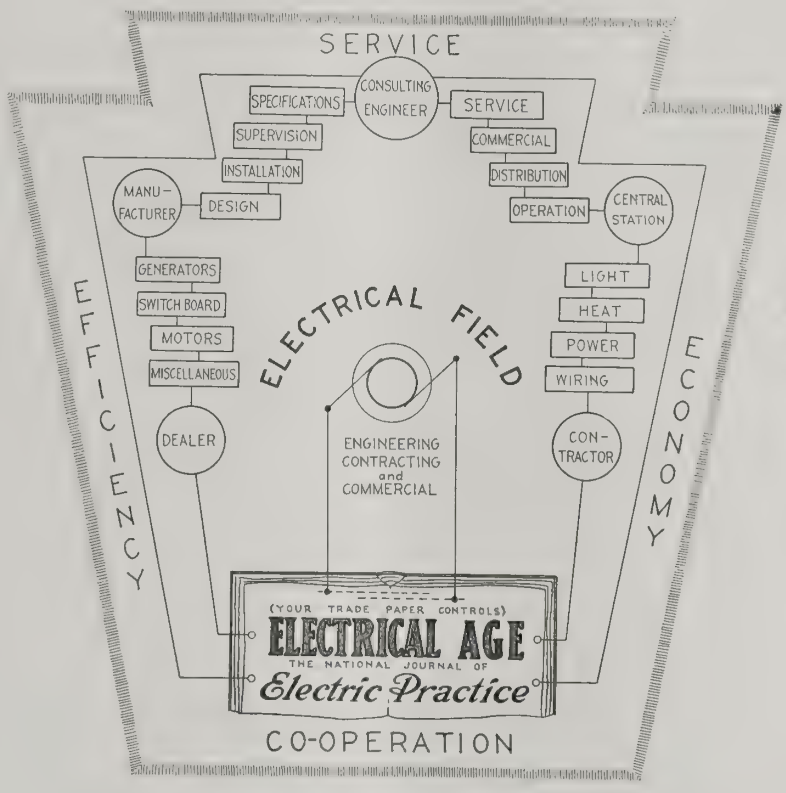
In making this change we are guided by the realization that in its 21 years of existence the scope of this journal has become constantly broader, and to fulfill the demand of the rapidly increasing number of readers, the contents of the paper has generally been improved and thus we began to think that the old name was not broad enough and the more characteristic title of ELECTRICAL AGE was adopted.

We feel certain that you will sanction our judgment that ELECTRICAL AGE is characteristic of the times and extends over the broad and varying field of electric practice. We realize that a trade paper really forms the keystone supporting any particular line of endeavor and ELECTRICAL AGE, your trade paper, must be the keystone supporting the broad field of electrical activities and in this way a truly *National Journal of Electric Practice* will be realized.

Our business interests are all mutual regardless of whether one may be a contractor and the other a manufacturer. The ELECTRICAL AGE lends the necessary control to bring about service, efficiency, and economy by its automatic co-operation. By examination of the diagram herewith this feature is emphasized in concrete form, it shows conclusively that one part of the trade and industry is directly inter-related to the other. In interpreting this illustration bear in mind its analogy to a complete interweave of an electrical circuit system.

As a reader you expect to find in these columns information on subjects intimately related to the electrical field. As an engineer or operator, contractor or electrician, jobber or manufacturer, you will always find a number of helpful articles in your particular sphere. Of course, the field of electric practice is so extensive that these various subjects each divide into inter-related branches and if you will only let us hear from you we will put forth every effort to meet the growing demands.

With our editorial department located in the metropolis, we are well situated to give prompt and better service for the interests of our readers. This is made possible by the fact that New York is the greatest publishing center and the most progressive city in the world with respect to things electrical.



THE KEYSTONE SUPPORTING THE ELECTRICAL FIELD; SHOWING THE RELATION OF THE VARIOUS INTERESTS WITH RESPECT TO EACH OTHER

Governmental Recognition of Engineers

With the tumult of the European hostilities resounding on our side of the Atlantic the various departments of our national government have had some cause for action. This stir does not perhaps in every instance bear directly on the world-war, but the activities may certainly be traced to it, even though indirectly.

From an engineering viewpoint the most potent action is that taken by Secretary Daniels in creating the Naval Advisory Board. This board consists of a representative body of private engineers and scientists who have been selected from the respective national societies, and on these the government will rely for the improvement of the navy.

Eleven engineering and scientific societies were each requested to nominate two members for the Board and such selections were all acceptable to the government. Thus the personnel consists of twenty-three leaders of engineering, science and invention, including Thos. A. Edison, the chairman. To be more explicit, this group comprises men eminent in their particular field, covering

inventions, engineering—electrical, mechanical, civil, mining—mathematical and chemists.

With this recognition of American genious the U. S. Navy will be the first to get the benefit of all new developments.

Signs of the Times

ANSWERS to inquiries as to the status of the broad electrical and allied interests prove conclusively that the signs of the times point toward prosperity.

This time of the year has always been the period for putting forth the best efforts to stimulate business. Perhaps the first move is the actual activity among the men of the industry proper, and the fact that seventeen conventions, the country over will have been concluded by the time this journal is received certainly speaks for itself.

Though it has often been said that it is a difficult undertaking to bring competing forces together, co-operative action, however, in the electrical field is an accomplished fact. The Society for Electrical Development, representing the interests of central stations, manufacturers, jobbers, dealers and contractors, is now actively engaged in a comprehensive campaign designed to promote optimism, confidence, business and prosperity.

A statement by Arthur Williams, general commercial manager of the N. Y. Edison Company, based on his observations among numerous manufacturers of electrical equipment, points out that business has generally increased. That such increment is not due to the war is explained by the fact that many people have now come to realize that electricity is a necessity and not a luxury.

Besides the recognized co-operative efforts, manufacturers are independently conducting extensive educational campaigns so as to stimulate the use of electric current-consuming devices which must result, of course, in a more general use of electricity for all purposes.

Purchasing Power Stock on Part Payment Plan

Investment in the 7 per cent. preferred stock of the Northern States Power Company by electric and gas customers of the organization has attracted considerable attention. The recent offer of stock on the partial payment plan has caused a large number of inquiries and many sales. The Chicago financial weekly "Investment News" recently had a long article describing the movement and pointing out its many economic advantages, part of which follows:

Any electric or gas customer of the Northern States Power Company organization can now walk into the office of the local operating unit and purchase the company's 7 per cent. preferred stock, which has paid dividends regularly each quarter since organization in 1909. The customer has the option of purchasing for cash or on the installment plan. If he selects the latter he pays $5 down and an equal amount each month, but his purchase is limited to ten shares.

Though the customer may wish to purchase as little as one share, par value $100, he is welcomed as a prospective investor and stockholder in the company. He will find the manager glad to tell him about the organization, its capitalization, earnings, prospects, etc., and to equip him with a 50-page printed annual report, verified by independent certified public accountants.

Instead of classifying himself as a "consumer," the customer of the company learns that he is regarded as an investor and partner, and may secure a proprietory interest and a pro rata of the earnings of one of the public utilities serving his community.

All this is a step in the so-called "democratization of ownership of the corporations," much written about in the past and at last actually fairly under way, not only with the railroads, but in the affairs of electric and gas utilities directed by progressive and far-seeing management concerns.

Cleaning Fields of Turbo-Generators

THE frequency with which the field of a turbo-generator should be taken out for the purpose of cleaning is a matter of operating conditions.

The radiating surface of a turbo-generator is generally small for its rated output, this surface decreasing rapidly with increasing output, with the result that forced ventilation is resorted to in all but the smallest machines. On the small machines fans are placed in the machines themselves, drawing the air from the surrounding media. But with large machines enormous volumes of air are required, necessitating extremely high velocities, so that separate blowers are compulsory. With such large quantities of air passing through the machine a considerable amount of foreign matter is liable to be carried into the ventilating ducts, gradually accumulating there until the air passages are completely blocked. To obviate this difficulty the air must be cleaned as thoroughly as possible by filtering and washing.

It is safe to say that the larger the capacity of the machine the less frequent need be the cleaning, because the air passages are larger, the air velocities higher, and the air washing more carefully looked after than with the smaller machines.

The writer knows of several stations where the fields are cleaned but once a year, and are often not cleaned for even longer periods. And then again, at other stations semi-annual cleaning is necessary. It is a matter of operating conditions and environment; generally a cleaning once every two months is too often even under extremely unfavorable conditions. Why not insert "exploring coils" in the armature or stationary winding of the machines, or one of the machines, and obtain the temperatures, say, every month or so? This is done by one of the largest central station companies in the country, and they are able to decide with the greatest ease when a machine requires to be cleaned by the temperature rise of the armature winding.—*I. L. K.*

Demonstrations with a new type of electric sign held in London, have aroused considerable interest. It differs materially from the prevailing signs of this character which display words and phrases, for the reason that it can be made to show any desired message within the capacity of its letters virtually at a moment's notice; moreover, the message may be read either by day or by night. The elements are of special design, consisting of an array of white circular members, each of which is fitted with two metallic covers resembling eyelids. These are rotated by means of an electric motor in such a way as to uncover the discs.

Behind each of these is placed an electric light for illuminating purposes at night. In the sign with which the demonstrations were carried out there are nearly 2,000 elements, and these are coupled to a single keyboard, which is selectively placed in relation with each monogram. By means of this keyboard the legend of the sign can be changed once a minute; consequently the idea is extremely useful for the flashing of news. The versatility of the sign is its most salient feature, and in its application to recruiting operations it has proved extremely effective.

Lighting

A Practical Review of the latest developments in domestic, commercial and industrial illumination.

New Street Lighting---Fixtures---Show Window and White Way Lighting

Progress in the Art of Lighting

WITH the successful close of the ninth annual convention of the Illuminating Engineering Society, held in Washington, D. C., September 20 to 23, there becomes available a record of new and valuable information on every phase of the problem of lighting. There were about two hundred and fifty in attendance at the various sessions, including the leading men in the field of research and design, representatives of manufacturers, the central gas and electric companies and many independent engineers.

The presentation and discussion of the many individual papers disclosed facts and figures on extensive special investigations conducted by authorities of recognized standing. These cover the practical problems encountered by the illuminating engineer together with the scientific data necessary in such considerations. For the commercial man there were presented many interesting contributions on better lighting service. The society as a whole, through its various technical committees presented several very interesting reports and the one dealing with terminology, definitions and symbols is perhaps of paramount importance. This forms the 1915 report of the committee on Nomenclature and Standards, representing a commendable work by the committee to bring about international standards for the use of the illuminating engineer; the values are therefore based on the C. G. S. system. This paper, containing many new and revised definitions, was read by Dr. C. H. Sharp, secretary of the committee, and is given herewith.

Incandescent Lamps and the Street Lighting Problem*

By W. H. Rolinson

THE purpose at this time is to outline the progress of street lighting by mazda type "C" tungsten lamps. These lamps have been on the market not over a year and a half, yet this seems to have been long enough to establish confidence in them, especially in the types that are used in street lighting. At present there are almost half a million of these lamps installed and operated successfully in streets in the United States and the number is being increased rapidly.

The many and varied conditions encountered in street lighting have long required units of a wide range in candlepower for street service. It is therefore not surprising that the development of the lamps, and the design of fixtures and other controlling accessories for their proper application, has progressed rapidly. It is now possible, at a comparatively low cost and at excellent efficiency, to provide street illumination of any intensity with this form of illuminant.

Circuit Systems

Street lighting on multiple circuits is not common in the United States although it is extensively used in New York City and with such systems very satisfactory results are being secured. The series system is generally installed in one of the following ways:

1. Constant current (moving coil) regulators with film cutout sockets. 2. Adjustor socket systems. 3. Series reactance coil regulators or phase displacement transformers with film cutout sockets. 4. Series film cutout sockets directly connected in series across constant voltage circuits.

As far as is known the life performance of series tungsten lamps on direct current circuits is the equivalent of their performance on alternating current circuits although some peculiar characteristics have been noted on such circuits, particularly in conjunction with certain kinds of arc lamps which tend to set up excessive line surges. As yet these lamps cannot be generally recommended for operation on any form of direct current series circuit. However, such little difficulties as have appeared in the past are rapidly being overcome so that within a very short time many of the disadvantages of such operation are expected to be eliminated.

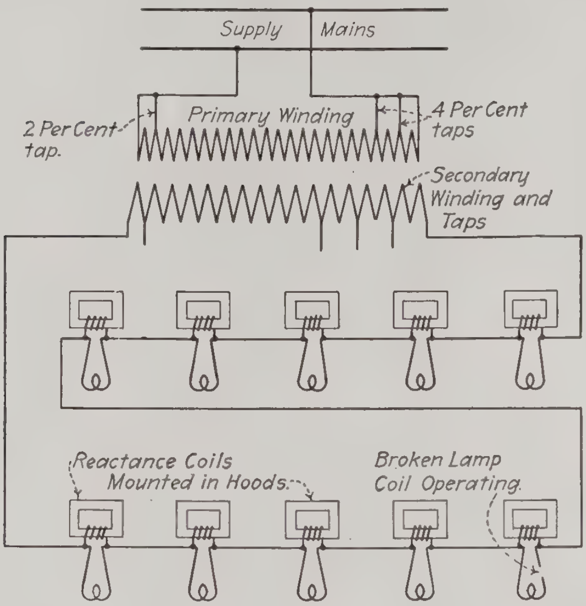
For alternating current, the constant current regulator system is one of the most satisfactory methods of operating gas-filled tungsten lamps for street lighting. The most common form consists of a primary and secondary coil surrounding a common core, one of which coils is movable and balanced by a counter weight. The principal advantage of this form of distribution system is, that with grounds and short circuits on the secondary the moving coil changes its position to maintain normal current regardless of their severity, doing so within three seconds.

The film cutout socket for such a system is comparatively well known and consists essentially of the two brass jaws of the socket held apart by a thin piece of insulation. The failure of the lamp causing the full voltage of the open circuit to be impressed against this insulation, which punctures, allowing the circuit to remain uninterrupted.

The adjustor socket system differs from other methods in that a different type of lamp cutout is employed. It consists of a multiple socket which is shunted by a reactance coil permanently connected in circuit. This reactance coil is designed so that when a lamp is in circuit the coil takes only an exciting

*From a paper presented at the Ninth annual convention of the Illuminating Engineering Society.

current which approximates 2 per cent. of the line current. When the lamp fails or is removed all the current is forced through the coil, which introduces a high reactance in series with the other lamps, and thus prevents the current from rising unduly although operated on a constant potential circuit. The system is operated in connection with a constant potential transformer which is provided with suitable voltage taps to enable the adjustment of the circuit voltage to within 1 per cent. of that required. The illustration shows a characteristic diagram of this circuit.



CIRCUIT DIAGRAM OF ADJUSTOR-SOCKET A.C. SERIES STREET LIGHTING SYSTEM

The series reactance coil regulator is a device consisting of a constant potential transformer with an adjustable reactance in series with a circuit of lamps, cutting down the power factor to approximately 80 per cent. and thereby reducing the rise in current from any cause. With any change from normal conditions, such as lamp outage, double grounds and short circuits on the lamp circuit, the current rises approximately 70 per cent. as much as it would if no reactance regulator were used. This system is used very rarely and it cannot be recommended as a satisfactory system, except for temporary purposes.

The series film cutout system using lamps connected directly in series across constant voltage circuits with film cutout sockets, is primarily an emergency system. It is too unreliable to warrant risking lamps in any considerable number because of the chance of a few lamps burning out and perhaps destroying those remaining.

In the two graphs presented are shown the regulation characteristics of the different circuits briefly outlined above, with various percentages of lamps inoperative and with a 10 per cent. rise of the primary voltage. A study of these curves will indicate the superiority of the constant current transformer system from the standpoint of its reliability and protective features to the lamps on the system..

Although the lamps in themselves contain a sufficient factor of safety for satisfactory operation, on the more commonly employed forms of series lighting circuits the matter of regulation on such circuits should be given considerable attention. On lamps of the larger sizes it is recommended that from the standpoint of efficiency, as well as the factor of safety introduced, that the 15 and 20-ampere lamps be operated in conjunction with autotransformers. At average prices of power the autotransformer or compensator pays for itself within a few months, in the wattage saved over the less efficient lower current lamps, and in itself provides additional protection to the lamp.

The autotransformer eliminates the necessity for a film cutout socket inasmuch as the open circuit voltage of the secondary of the autotransformer amounts to only two or three times the lamp voltage and the autotransformer is not injured by continuous operation on open circuit. The autotransformer is essentially a current transformer. A single winding is used for the sake of economy as there would be no advantage in making two windings insulated from each other, using considerably more material to obtain the same results. With the present autotransformer a core type construction is used. First, for ease of permanent insulation; second, for high efficiency and power factor because of size and compactness, and third, uniformity of performance with reference to leakage and compensation. The autotransformer itself costs approximately the same as the lamp, which is used with it.

PERFORMANCE OF SOME STANDARD SIZES OF AUTOTRANSFORMERS, 6.6 AND 7.5-AMPERE PRIMARY AT 60 CYCLES

Cp.	Lamp current	Efficiency	Watts	Power factor
400	15	94.5	200	98
600	20	95.2	282	98
1000	20	95 8	450	98

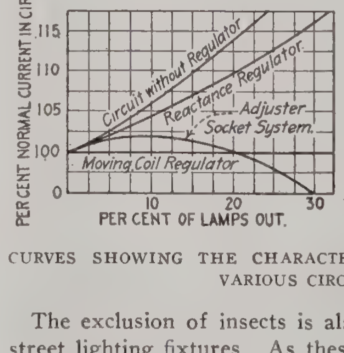
Fixtures and Glassware

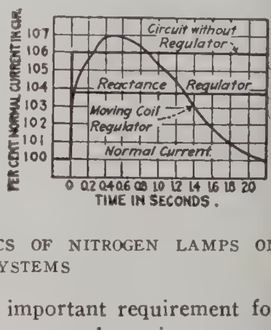
The large, high candlepower lamps on account of their characteristics and extreme brilliancy require that they be used in connection with proper fixtures suitably adapted to the lamp and the conditions of service. The life of the lamp and the efficiency of the complete unit are vitally affected by the kind of globe, size, and the ventilating facilities of the fixture.

To get a reliable and adequate service from these high candlepower gas-filled tungsten lamps the fixtures must be designed in such a way as to give not only adequate ventilation but at the same time provide complete protection from the elements; the lamp bulb being extremely hot will crack on exposure to rain or snow, making it essential that the feature of protection be complete under all conditions.

The smaller street series lamps of 250 candlepower or less can be operated in the ordinary forms of street hoods without any additional protection from the weather. The ordinary street hoods protect the upper parts of the lamp sufficiently and the lower portions of the lamp, being comparatively cool, are not affected.

The position in which a gas-filled tungsten series lamp is burned very often materially affects the life of the lamp. The regularly manufactured series lamps are designed to operate in a pendant position, tip-down, but very often the fixture to which the lamp must be adapted requires that it be operated in a tip-up position. In such cases special construction is necessary in order that a satisfactory life be obtained from the lamps. Care should always be taken to specify the position of burning in order that the right lamp will be secured.





CURVES SHOWING THE CHARACTERISTICS OF NITROGEN LAMPS ON VARIOUS CIRCUIT SYSTEMS

The exclusion of insects is also an important requirement for street lighting fixtures. As these fixtures are hung in comparatively inaccessible places the frequency of visits necessary to remove insects should be reduced as much as possible; this can be taken care of by selecting fixtures of proper construction and design.

There are a great many fixtures on the market suitable for operating these lamps. Most of these are so standardized that they can be used interchangeably on various circuits and are also standardized so as to adapt a variety of diffusing globes and refractors.

A globe for diffusing the light from a concentrated tungsten filament gas-filled lamp is very desirable, especially where it is mounted in such a way as to fall within the line of vision.

While diffusing glass is recommended and has many advantages it has also the disadvantage of reducing the efficiency of the unit. The ideal globe, of course, is one which is of sufficient diffusing power to entirely conceal the lamp filament and become itself a secondary source of light, thus becoming luminous over its entire surface without the absorption of too great an amount of light flux. Opalescent glass commonly used absorbs from 15 to 30 per cent. of the light.

The globes made of cased glass of two different mixtures are very valuable; such glass is usually of the best diffusion quality and correspondingly ornamental. Although the light absorption is somewhat greater than the common opalescent glasses, the absorption is diminished by having it relatively thin and part of the thickness of the globe made of clear glass.

A refractor if carefully placed with reference to the light source can be used to redirect the light rays in desirable directions. It is obvious that the character of light distribution of units for street lighting is a matter of considerable importance and fixtures used should have been designed with this point in view.

Lighting Systems

Lamps of the larger sizes have been used quite successfully in many of the larger cities of the country. In the majority of instances no attempt has been made to adopt any new method of installation, spacing of units or mounting height; usually the new lamps and fixtures that have replaced the various forms of carbon arc lamps have been located on the same poles. In practically every instance where these lamps have replaced arc lamps, incandescent units of greater candlepower were selected, resulting in increased illumination.

Ornamental systems of street lighting, have become very popular in many communities. The new type of gas-filled tungsten has simplified this system by stimulating the demand for single lamp standards. The five-lamp light clusters, which were installed in such large numbers in the business sections of smaller cities, are now becoming less of a factor, being superseded by the single lamp standards of artistic design. Lamps of the 400 and 600-candlepower size adapt themselves very readily to single light posts of any ornamental lighting system.

By means of a two-winding transformer placed in the pole base, using 400-c.p., 15-ampere or the 600-c.p., 20-ampere lamps, a very ornamental and efficient form of street lighting can be employed as the use of the two-winding transformer in the pole base provides means of carrying a low tension current up through the pole, making it a very satisfactory street series system.

The subject of lighting of highways, state roads or other long interconnecting roads between communities, which in general remain unlighted, deserves some consideration.

With the steady extension of transmission and distribution systems through the more sparsely settled sections of the country the chief item of expense, pole line construction, is minimized. In many localities lighting along highways of this character can often be carried out on transmission lines in the immediate vicinity by means of low candlepower lamps fitted either with radial wave reflectors or with lamps and reflectors supplemented by the prismatic refractors. Generally speaking, lighting of this nature can be considered merely to be beacons and no pretense has been made to illuminate the roadway uniformly.

Though small lamps are used in highway lighting the suspension should be as near the center of the road as possible and not materially lower than 18 ft. above the street surface. On ordinary dirt roads the 100 candlepower lamps with radial wave reflectors, either with or without refractors, spaced 200 to 300 ft. apart, appear to give very satisfactory results.

On the better class of state roads where road surfaces have been oiled and have become somewhat polished through vehicular traffic, larger units of 250 to 400-candlepower sizes spaced from 500 to 600 ft. apart at heights not less than 20 ft. prove a more satisfactory form of illumination. It is, of course, necessary in all cases to have the units located with references to the natural obstacles.

Definitions and Standards for Use in Illumination Calculations*

Illumination, on a surface, is the luminous flux-density over that surface, or the flux per unit of intercepting area.

Luminous flux is radiant power evaluated according to its capacity to produce the sensation of light.

The stimulus coefficient K_y for radiation of a particular wave length is the ratio of the luminous flux to the radiant power producing it.

The mean value of the stimulus coefficient K_m, over any range of wave-lengths, or for the whole visible spectrum of any source, is the ratio of the total luminous flux in lumens, to the total radiant power in ergs per second, but more commonly in watts.

The luminous intensity of a point source of light is the solid angular density of the luminous flux emitted by the source in the direction considered; or it is the flux per unit solid angle from that source.

Candle—the unit of luminous intensity maintained by the national laboratories of France, Great Britain, and the United States.

Candlepower—luminous intensity expressed in candles.

Mean horizontal candlepower of a lamp—the average candlepower in the horizontal plane passing through the luminous center of the lamp.

It is here assumed that the lamp (or other light source) is mounted in the usual manner, or, as in case of an incandescent lamp, with its axis of symmetry vertical.

Mean spherical candlepower of a lamp—the average candlepower of a lamp in all directions in space. It is equal to the total luminous flux of the lamp in lumens divided by 4×3.1416.

Mean hemispherical candlepower of a lamp, upper or lower—the average candlepower of a lamp in the hemisphere considered. It is equal to the total luminous flux emitted by the lamp in that hemisphere divided by 2×3.1416.

Mean zonal candlepower of a lamp—the average candlepower of a lamp over the given zone. It is equal to the total luminous flux emitted by the lamp in that zone divided by the solid angle of the zone.

Spherical reduction factor of a lamp—the ratio of the mean spherical to the mean horizontal candlepower of the lamp.

Lumen—the unit of luminous flux, equal to the flux emitted in a unit solid angle or steradian by a point source of one candlepower.

Lux—a unit of illumination equal to one lumen per square meter.

Exposure—the product of an illumination by the time. Blondel has proposed the name "phot-second" for the unit of exposure in the C. G. S. system.

Specific luminous radiation—the luminous flux-density emitted by a surface, or the flux emitted per unit of emissive area. It is expressed in lumens per square centimeter.

* From paper presented at the ninth annual convention of the Illuminating Engineering Society.

Brightness, b, of an element of a luminous surface from a given position, may be expressed in terms of the luminous intensity per unit area of the surface projected on a plane perpendicular to the line of sight, and including only a surface of dimensions negligibly small in comparison with the distance of the observer.

Normal brightness, b_0, of an element of a surface, sometimes called specific luminous intensity, is the brightness taken in a direction normal to the surface. (Note: In practise, the brightness b of a luminous surface or element thereof is observed, and not the normal brightness b_0. For surfaces for which the cosine law of emission holds, the quantities b and b_0 are equal.)

Coefficient of reflection—the ratio of the total luminous flux reflected by a surface to the total luminous flux incident upon it. It is a simple numeric. The reflection from a surface may be regular, diffuse or mixed. In perfect regular reflection, all of the flux is reflected from the surface at an angle of reflection equal to the angle of incidence. In perfect diffuse reflection the flux is reflected from the surface in all directions in accordance with Lambert's cosine law. In most practical cases there is a superpostition of regular and diffuse reflection.

Coefficient of regular reflection is the ratio of the luminous flux reflected regularly to the total incident flux.

Coefficient of diffuse reflection is the ratio of the luminous flux reflected diffusely to the total incident flux.

Lamp—a generic term for an artificial source of light.

Comparison lamp — a lamp of constant but not necessarily known candlepower against which a working standard and test lamps are successively compared in a photometer.

Test lamp, in a photometer—a lamp to be tested.

Primary luminous standard — a recognized standard luminous source reproducible from specifications.

Representative luminous standard—a standard of luminous intensity adopted as the authoritative custodian of the accepted value of the unit.

Reference standard—a standard calibrated in terms of the unit from either a primary or representative standard and used for the calibration of working standards.

Working standard — any standardized luminous source for daily use in photometry.

Performance curve—a curve reprsenting the behavior of a lamp in any particular (candlepower, consumption, etc.) at different periods during its life..

Characteristic curve—a curve expressing a relation between two variable properties of a luminous source, as candlepower and volts, candlepower and rate of fuel consumption, etc.

Horizontal distribution curve—a polar curve representing the luminous intensity of a lamp, or lighting unit, in a plane perpendicular to the axis of the unit, and with the unit at the origin.

Vertical distribution curve—a polar curve representing the luminous intensity of a lamp, or lighting unit, in a plane passing through the axis of the unit and with the unit at the origin. Unless otherwise specified, a vertical distribution curve is assumed to be an average vertical distribution curve such as may in many cases be obtained by rotating the unit about its axis, and measuring the average intensities at the different elevations. It is recommended that in vertical distribution curves, angles of elevation shall be counted positively from the nadir as zero, to the zenith as 180°. In the case of incandescent lamps, it is assumed that the vertical distribution curve is taken with the tip downward.

Photometric tests in which the results are stated in candlepower should be made at such a distance from the source of light that the latter may be regarded as practically a point. Where tests are made in the measurement of lamps with reflectors, the results should always be given as "apparent candlepower" at the distance employed, which distance should always be specifically stated.

The output of illuminants should be expressed in lumens.

Illuminants should be rated upon a lumen basis instead of a candlepower basis..

The specific output of electric lamps should be stated in terms of lumens per watt and the specific output of illuminants depending upon combustion should be stated in lumens per British thermal unit per hour. The use of the term "efficiency" in this connection should be discouraged.

When auxiliary devices are necessarily employed in circuit with a lamp, the input should be taken to include both that in the lamp and that in the auxiliary devices. For example, the watts lost in the ballast resistance of an arc lamp are properly chargeable to the lamp.

The specific consumption of an electric lamp is its watt consumption per lumen. "Watts per candle" is a term used commercially in connection with electric incandescent lamps, and denotes watts per mean horizontal candlepower.

Life tests—Electric incandescent lamps of a

PHOTOMETRIC UNITS, FORMULAS AND ABBREVIATIONS.

Photometric quantity	Name of unit	Abbreviations, symbols and defining eqations
1. Luminous flux	Lumen	F. Ψ
2. Luminous intensity	Candle	$I = \frac{dF}{d\omega}, \Gamma = \frac{d\Psi}{d\omega}$, cp.
3. Illumination	Phot, foot-candles, lux	$E = \frac{dF}{dS} = \frac{I}{r^2} \cos\theta.\ \beta$
4. Exposure	Phot-second	Et
5. Brightness	Apparent candles per sq. cm. Apparent candles per sq. in.	$b = \frac{dI}{dS\cos\theta}$
	Lambert	$L = \frac{dF}{dS}$
6. Normal brightness	Candles per sq. cm. Candles per sq. in.	$b_0 = \frac{dI}{dS}$
7. Specific luminous radiation	Lumens per sq. cm. Lumens per sq. in.	$E' = \pi b_0, \beta'$
8. Coefficient of reflection		$m = \frac{E'}{E}$
9. Mean spherical candlepower		scp
10. Mean lower hemispherical candlepower		lcp
11. Mean upper hemispherical candlepower		ucp
12. Mean zonal candlepower		zcp

13. 1 lumen is emitted by 0.07958 spherical cp.
14. 1 spherical candlepower emits 12.57 lumens.
15. 1 lux = 1 lumen incident per square meter = 0.0001 phot = 0.1 milliphot.
16. 1 phot = 1 lumen incident per sq. cm. = 10,000 lux = 1000 milliphot.
17. 1 milliphot = 0.001 phot = 0.929 foot-candle.
18. 1 foot-candle = 1 lumen incident per square foot = 1.076 milliphot 10.76 lux.
19. 1 lambert = 1 lumen emitted per square centimeter.*
20. 1 millilambert = 0.001 lambert.
21. 1 lumen, emitted, per square foot* = 1.076 millilambert.
22. 1 millilambert = 0.929 lumen, emitted, per square foot.*
23. 1 lambert = 0.3183 candle per sq. cm. = 2.054 candles per sq. in.
24. 1 candle per sq. cm. = 3.1416 lamberts.
25. 1 candle per sq. in. = 0.4868 lamberts = 486.8 millilamberts.

* Perfect diffusion assumed.

given type may be assumed to operate under comparable conditions only when their lumens per watt consumed are the same. Life test results, in order to be compared must be either conducted under, or reduced to, comparable conditions of operation.

In comparing different luminous sources, not only should their candlepower be compared, but also their relative form, brightness, distribution of illumination and character of light.

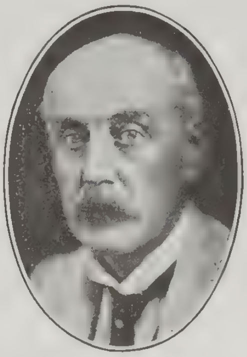
Lamp Accessories.—A *reflector* is an appliance the chief use of which is to redirect the luminous flux of a lamp in a desired direction or directions. A *shade* is an appliance chiefly used to diminish or to interrupt the flux of a lamp in certain directions where such flux is not desirable. Its function is commonly combined with that of a reflector. A *globe* is an enclosing appliance of clear or diffusing material the chief use of which is either to protect the lamp or to diffuse its light.


BENJ. G. LAMME


FRANK JULIAN SPRAGUE


THOMAS A. EDISON


PETER COOPER HEWITT


ANDREW MURRAY HUNT

THE U. S. NAVAL ADVISORY BOARD

IN THE main, the personnel of the new Naval Advisory Board as announced by Secretary Daniels, is composed of leaders in the electrical field, Americans of ingenuity, adaptation, inventive talent and scientific attainments. The Board is headed by Thomas A. Edison with its members representing the various scientific and engineering institutions of national reputation.

Mr. Edison needs no introduction. The others of the Board, and the societies they represent are as follows:

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Frank Julian Sprague, of New York, was born 1857, graduated from the Naval Academy with honors in 1878. He served in the navy until 1883 when he became Mr. Edison's assistant in electric light experiments and devised a mathematical system for determining the characteristics of central station distribution. In 1884 he founded the Sprague Electric Railway Motor Company and began the application of electric motors to stationary work and directed the building of the first typical electric trolley railways in this country and abroad. Later he founded the Sprague Electric Elevator and Sprague Electric Companies. In 1895 he invented the multiple-unit system of electric train control for increasing traffic capacity now used on all elevated and subway roads and all electric train operation where two or more locomotive units are under a common control. He is the inventor of a system of control for automatic braking of trains; and is also concerned in the development of high angle fire shrapnel.

Benjamin G. Lamme, of Pittsburgh, was born in 1864 and graduated from the Ohio State University as a mechanical engineer in 1888. He entered the employ of the Westinghouse Electric and Mfg. Co. in the testing department and later took up design work. He is now chief engineer of the company. He has been a leader in the development of alternating current appratus including the induction motor, polyphase generators, rotary converters and single phase railway apparatus. He was also a pioneer in the development of the first direct current apparatus for railway lighting and power work. As an electrical engineer, Mr. Lamme is known widely. He is an exceedingly fertile inventor and has to his credit a very large number of important patents covering tlectrical apparatus.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

William Le Roy Emmett, of Schenectady, N. Y., was educated at the Naval Academy and graduated in 1881. His most important electrical work has been in the development of the general use of alternating currents. He designed the Curtis turbine and was the first serious promoter of electric ship propulsion.

Spencer Miller, of Orange, N. J., attended the Worcester Polytechnic Institute and was graduated in 1879. He is known for his work as an inventor of a marine cableway for coaling ships at sea and as designer of the overhead cableway system used in the Panama Canal. He also invented the breeches buoy cableway apparatus used by U. S. revenue cutters for rescuing passengers in a heavy sea.

AMERICAN CHEMICAL SOCIETY

W. R. Whitney, of Schenectady, N. Y., Massachusetts Institute of Technology, '90, is the director of research at the General Electric Company's laboratory. He is noted for his work in vacuum tubes, wire-drawn tungsten and the gas-filled incandescent lamp. He has also had important success with the photographic filament.

Dr. L. H. Baekeland, of Yonkers, N. Y., was graduated from the University of Ghent 1882. He invented Velox and other photographic papers, the Townsend electrolytic cell and photographic films and dry plates.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Andrew Murray Hunt was born in Iowa in 1859. In 1875 he was appointed to the United States Naval Academy as a cadet engineer and was graduated in 1879. He served in the engineering corps until 1894 when he resigned and engaged in consulting engineering work on the Pacific Coast. His work has included hydro-electric developments, irrigation, steam power plants, gas plants, oil refineries, cement manufacturing plants, heavy acid plants and other lines He has recently organized a corporation with headquarters in New York for general consulting engineering work.

Alfred Craven, of New York, Naval Academy '67, has distinguished himself in irrigation work in California and in the construction of the Sutro tunnel, Virginia, the Croton Aqueduct and reservoirs, the Carmel and Titicus dams and reservoirs, the Jerome Park reservoir and New York subway work. He has served as chief engineer of the New York Public Service Commission since 1910.

THE INVENTORS' GUILD

Peter Cooper-Hewitt, grandson of Peter Cooper, the philanthropist, was born in New York in 1861 and educated at the Stevens Institute of Technology and Columbia University. He is chiefly known for his invention of the mercury-vapor electric lamp, mercury rectifier and mercury-vapor rectifier. He is the inventor of a telephone relay, electric wave amplifier, wireless telephone and telegraph apparatus, hydroplane, aeroplane and dirigible balloon apparatus and light transformers, changing the color of light rays.

Thomas Robbins, of Connecticut, is the inventor of a be't conveyor for carrying ore and coal and is the president of the Robbins Conveying Belt Company. He was educated at Princeton.

AMERICAN ELECTRO-CHEMICAL SOCIETY

Joseph W. Richards, of South Bethlehem, Pa., received his education at Lehigh University and was graduated in 1886. He studied also at German universities and is a legal expert in chemical and metallurgy cases. He is at present professor of electro chemistry at Lehigh.

Lawrence Addicks, of Douglas, Ariz., M. I. T. '89, is a consulting engineer and an authority on the metallurgy of copper.

AMERICAN INSTITUTE OF MINING ENGINEERS

William Laurence Saunders, of New York, University of Pennsylvania '76, has designed apparatus for subaqueous and rock drilling, quarrying and the radial axe system of coal mining. He also invented the system of pumping liquids by compressed air now in use in the Russian oil fields.

Benjamin Bowditch Thayer, of New York, Harvard '85, is president of the Anaconda Copper Mining Company and an expert on copper and high explosives.

AMERICAN MATHEMATICAL SOCIETY

Dr. Robert Simpson Woodward, Washington, D. C., Michigan '72, is a civil engineer and authority on astronomy, geography and mathematical physics. He is president of the Carnegie Institute.

Dr. Arthur Gordon Webster, of Worcester, studied at Harvard and abroad. He is professor of physics at Clark University and an authority on sound.

AMERICAN SOCIETY OF AUTOMOBILE ENGINEERS

Andrew L. Riker, Detroit, is vice-president of the Locomobile Company, and an electrical and mechanical engineer. He produced the first toothed armature and some of the first electric vehicles and marine lighting plants.

Howard E. Coffin, Detroit, Michigan '96, is vice-president of the Hudson Motor Car Company and has been prominently identified with the development of internal-combustion engines.

AMERICAN AERONAUTICAL SOCEITY

Hudson Maxim, of Brooklyn, N. Y., needs little introduction. He is the foremost ordinance and explosive expert in the country.

Matthew Bacon Sellers, of Baltimore, was educated at the Lawrence Scientific School and in France and Germany. He was the first to determine the dynamic wind pressure on arched surfaces by means of a "wind tunnel."

AMERICAN SOCIETY OF AERONAUTIC ENGINEERS

Elmer Ambrose Sperry, of Chicago, Cornell '76. He is chiefly known as the designer of electric appliances and gyroscope stabilizer for ships and aeroplanes.

Henry Alexander Wise Wood, New York, famous for his inventions and manufacturing of printing machinery. He is regarded as one of the foremost men in aeronautics in this country.

Car Lighting

Ever since it became certain that electricity was to be the coming illuminant for railway train lighting as well as for general purposes, the method of its economical and efficient application has been an important problem to railway companies and officials. One of the first results of Edison's development of the incandescnt lamp was the application of it to train lighting. Curiously enough the English first made this attempt, in 1881, and the dynamo was placed in the baggage car, the electricity being generated from the car axle.

Many and various have been the attempts by many and various railway companies as well, to solve the question of axle-generated-electrically-lighted-trains. Among other companies the Northern Pacific has indulged in this and very successfully.

In 1909 the Northern Pacific Company experimented with, perhaps, the first axle machine designed to light an entire train. This machine was belt driven and was mounted on a cast steel sub-base firmly bolted to the top of the car truck.

In 1914 a new and improved machine of similar type and mounting was built and applied to the night train between St. Paul and Winnipeg.

This machine is operated by a Morse silent chain that runs from a car axle of a forward truck to a counter, or jackshaft, which in turn, by means of another and similar chain, drives the dynamo, or generator. The entire machine is bolted to the truck and extends up through the floor of the baggage car where it is encased in a wooden box.

The generator is equipped with ball bearings, the counter shaft with roller bearings. Both the axle and generator chains run exposed to view so that their condition may be easily observed. The chains on one equipment ran for 140,000 miles before they were removed. This chain is being repinned by the Morse Chain Company, who advise that it will be equivalent to a new chain when repinned.

One special point of interest is that the lamp voltage throughout the entire train is controlled and held constant by a single lamp regulator located in the dynamo car.

In 1912 the Northern Pacific's three St. Paul-Winnipeg fast trains were each equipped with one 4-k.w., 50-ampere, 80 volt, "Safety" axle-driven generator. In 1913, seven additional local trains on the Coast were equipped with like generators except that these were of "Gould Simplex" pattern.

In addition, the night trains between St. Paul-Minneapolis and Dulth-Minn., have been equipped with 17½-k.w. Axle Machine Train Lighters as the large chain driven axle machines are called.

The trains are supplied with batteries to keep the cars properly lighted when the trains are not in motion, or when cars are detached. The generators are so adjusted as to close the generator switches and become operative, automatically, at a speed of 12 miles an hour for slow local trains and 18 miles an hour for the fast trains which make fewer stops.

So far as the general public is more particularly concerned, the special advantages of this system of car-lighting are the availability of the current at all times and the consequent stable and uniform lighting of the cars whether standing still or in motion. As for the railway companies the economy and efficiency of operation, in various ways, appeals strongly to them in addition to the preceding reasons.

Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Motor Application in an Artificial Ice Plant

By Frank C. Perkins

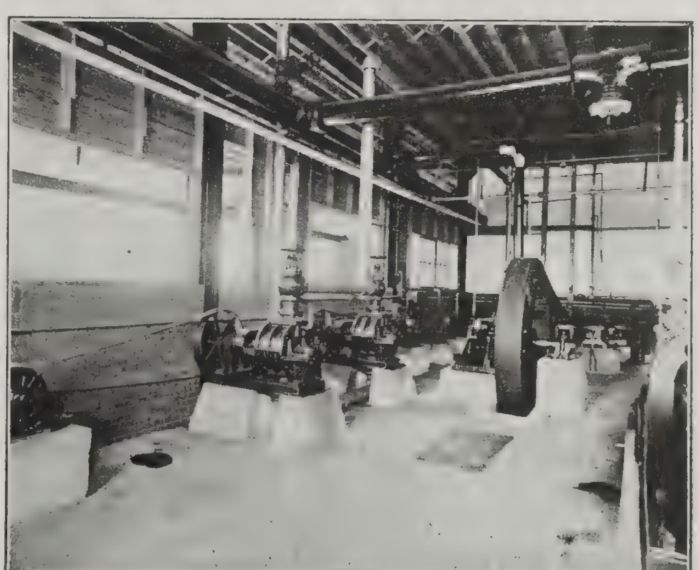
A MODERN electrically operated ice making plant, located in Chicago, and which is equipped with the most approved apparatus for making raw water ice, is the subject of this article.

The two motor driven ammonia compressors have cylinder dimensions of 13.5 by 26-in., giving a refrigerating capacity of 140 tons at 70 r. p. m. The fly-wheel is 16-ft. in diameter and has a 30-in. face weighing approximately 20,000 lbs. It is driven through a 28-in. double leather belt by a 3-phase, 60-cycle constant speed motor of 200 h. p. size.

The revolutions of the driving motor being constant, it has been necessary to resort to other means than change of motor speed for running the compressors at a maximum or minimum speed, according to the prevailing conditions that may have to be met. These extremes are secured by means of interchangeable paper driving pulleys, of 24-in. and 20-in. diameter, respectively. The larger of these pulleys will give a compressor speed of 75 r. p. m., while the smaller one will give 64 r. p. m. The sliding base of the motor, and facilities for easily shifting the pedestal of the outboard bearing, permits of ready pulley interchanging. Besides the two principal compressors, an 8 by 16-in. machine, with an 8-ft. belt-wheel, has been installed as a standby for emergency service and for supplying whatever refrigeration may be required during periods of suspension of the main industry. This small compressor is driven through a 12-in. double leather belt by an 80-h. p. induction motor.

Because of the constant speed motors used for driving the compressors, some method of by-passing the gas during the time of starting is necessary. Instead of being equipped with the usual full area by-pass pipe connection, the suction valves can be raised and held off by their seats by a small lever, which, when pushed in, is engaged by a spring on the outside of the valve bonnet until the motor is up to speed and then the lever is simply pulled out and the valves seat as usual. The machines are equipped with a central oiling system.

The general ammonia system is approximately as described herewith: The compressors receive the gas from the cooling system through 3-inch suction connections, and discharge through pipes of the same diameter. The main discharge line leads to a vertical oil trap 15 in. in diameter and 5 ft. long; the connection being in the shell of the trap, passing on to the condenser. Leaving the condenser the liquid ammonia flows to a 15-in. vertical receiver which is 9 ft. long, affording storage space for the ammonia. The liquid flows from the receiver through a precooler to a 3 x 6 ft. horizontal accumulator



AMMONIA COMPRESSOR ROOM IN A RAW-WATER ICE PLANT, SHOWING THE MOTOR DRIVEN AIR BLOWERS AND PUMPS. THE COMPRESSOR IS SEEN IN THE BACKGROUND

located above the brine tank in one end of the freezing room where the gravity feed system of cooling, or, as it is commonly called the flooded system, is employed.

The precooler is immersed in a section of the brine tank, adjacent to the accumulator and the currrent of newly condensed ammonia is cooled nearly to the temperature of the liquid in the flooded coils before it flows into the accumulator. Immediately the liquid passes the feed valve of the accumulator, a portion of it bubbles to the surface in the form of gas and then passes on through the suction piping to the compressor.

The freezing tank used for ice making measures 77 ft. long by 30 ft. wide, and 5 ft.-3-in. deep, being made of ¼-in. steel plate. It is insulated on the bottom with five inches of corkboard, and on the sides with twelve inches of granulated cork. The ammonia coils immersed in the freezing tank contain approximately 14,600 ft. of 1¼-in. extra strong pipe, which gives from 10 to 20 per cent. less coil surface than would be required with an ordinary expansion system. This brine tank holds 840 cans for making blocks of ice measuring 11 by 22 by 60 in. The agitation of the brine is accomplished by two rotary agitators placed in diagonally opposite corners of the tank and driven by vertical induction motors. The freezing tank room is also equipped with an electrically operated traveling crane and ice hoist.

An atmospheric cooling tower for condensing water is located on the roof of the plant building. On account of its light weight the problem of supporting the tower has presented no difficulties. The tower causes the water to rain down through successive stages, in a profusion of trickling currents, distributed to insure the maximum possible cooling effect with the lowest possible loss of water by wind and evaporation. Make-up water is taken from the city water supply system.

An atmospheric ammonia condenser stands in a cement-lined basin set into the roof of the building directly beneath the cooling tower. It is made up of 7,200 feet of 2-inch pipe arranged in eighteen vertical sections, each twenty pipes high. The water showering down through the cooling tower is collected in a basin mounted above the condenser and is then piped to triangular-shaped perforated pans which distribute the water over the condenser sections. The water collected in the condenser basin flows down a 6-inch pipe which branches to two centrifugal pumps located in the machine room. These operate at 1730 r. p. m., the larger of the two having a capacity of 500 gal. per minute, while the smaller one

ICE FREEZING TANK ROOM IN A RAW WATER ICE PLANT SHOWING THE ELECTRIC CRANE AND HOIST, TROLLEYS AND MOTOR DRIVEN AUXILIARIES

has a capacity of 250 gal. The former is driven by a 16-h. p. direct connected induction motor, while the latter is driven by a 10-h. p. motor of the same type. These pumps form a double equipment designed to provide a flexibility of service conformable to varying weather conditions.

The water for ice-making is drawn from the city main through duplicate filters, of 36 in. diameter and 48 in. high, into a 7 by 8 ft. circular tank mounted in a corner of the freezing room. As the water is undistilled, it is necessary, in order to produce ice of crystal clearness, to imitate Nature's processes while the freezing is going on in the cans. Natural ice from running streams, always is transparent because the freezing progresses in but one direction, from the top downward, while the flowing current keeps the slowly congealing under-surface continually washed. This is the secret of producing clear ice from raw water.

Since in the can system for manufacturing artificial ice the freezing goes on simultaneously from four sides, and as the water, if undisturbed, will remain perfectly quiescent, ice blocks of an opaque whiteness will be the inevitable result unless it is well stirred. The device employed in securing this result is to keep the water constantly agitated by a current of compressed air. The air is forced through a small pipe into each can of freezing water at 3-lbs. pressure. This keeps the water constantly stirred up. When the frozen block is within two inches or so of completion, the core at the center, which holds all of the impurities that may have been present in the original bulk of water, is drawn out and the remaining cavity is refilled with fresh raw water from the supply tank. The can is then left until the freezing is completed.

The result is a block of transparent ice with no more of whiteness through the core than will be found in ice made from distilled water, and with no considerable depression in the center of its top end. A duplicate installation of positive pressure air blowers, each with a capacity of approximately 420 cu. ft. of free air per minute, and discharging into a receiver of 42-in. diameter and 8 ft. high, has been provided for this service. Ample provision has been made for filtering and washing the air at the intake. These blowers are belt-driven by 10 h. p. induction motors. A rotary pump, belt-driven, by a 3-h. p. induction motor, is utilized for drawing the core water from the partially completed blocks of ice. The discharge from this pump passes overhead and mingles with the cooling water for the condensers.

As to current used for operation, it is said that ten days in midsummer an average of 76.2 tons of ice were produced per day, with a power consumption of 50.2 kw. hr. per ton.

Primary Batteries.—There are two variations of the primary battery distinguished by the use the cells may be put to and these are either of the open or closed circuit type. In form they may be wet or dry according to the manufacture.

Dry batteries are not unlike the other forms, except that the materials used are in a paste instead of liquid form. This feature has gained considerable popularity for dry cells; especially for portable work. The modern storage battery is not a primary apparatus, being sometimes called a secondary battery.

For closed circuits or for continuous operation, the crowfoot or gravity battery gives the most economic results, but for permanent installation on open circuits and where the demand on the battery is intermittent, some other form of wet battery is usually resorted to. Perhaps the best known cells for this class of work are of the Leclanche type.

Why The Readings Were Inconsistent

By E. C. Parham

DESIGNED as a 100-kilowatt, 8-pole alternater at a rating of 1150 volts and 80 amp., the machine was changed to 2,300 volts and 40 amp. by changing the revolving shunt and the rmature connections. In 1,150 volt operation, the series coils ad been connected two in parallel and four in series. On hanging to 2,300 volt operation, the series coils should all have een connected in series in order to get proportional comounding effect with the reduced current rating. But as this hange was not made, the series field effect was weaker than t should have been. In the diagram of Fig. 1 are shown the onnections of this class of alternator in which part of the xcitation is due to a rectified current that passes through he series field; the rest of the excitation is due to an exciter. As the rectified current is proportional to the external load, he machine is initially separately excited; in operation it is elf compounding. In the diagram the armature winding, comnutator, a revolving shunt and the collector rings are shown in he same plane for clearness; actually they are all supported by he armature shaft and turn with it.

As the commutator, usually called the rectifier, has the same umber of segments as the alternator has poles and as the arnature current can reach the series field only by way of the ectifier and its brushes, the current of the series coils is always n the same direction. The series field shunt, by means of vhich the degree of compounding is regulated, always carries ectified current. The revolving shunt being permanently conected to the rectifier segments, prevents the main line from eing opened when the rectifier brushes are passing from one egment to another and always carries alternating current.

The diagram suggests the possibility of so connecting the elf-exciting and separately exciting field windings as to have hem oppose each other in effect; such is possible especially n machines of 8 or more poles, because the rectifier segments re then narrow and the rectifier brushes need be shifted hrough only a small arc in order to reverse the polarity of the eries excitation.

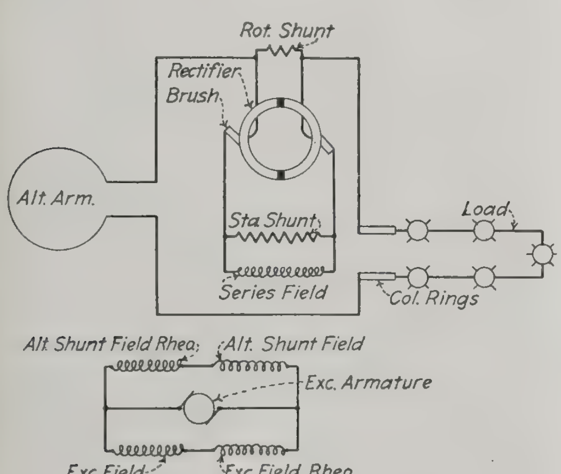


FIG. 1—ALTERNATOR DIAGRAM

During the several years that the machine in question had perated, voltage regulation had been effected by means of oth the alternator field rheostat and the exciter field rheostat. s there was no exciter voltmeter, the operator had never nown what the exciter voltage was. The first time that a dict current voltmeter became available, he ascertained that e exciter voltage was 145 volts when the alternator was less an half loaded. As the voltage rating of the exciter was 110 volts, he decided to lower it to that value and to raise the alternating voltage to normal again by cutting resistance out of the alternator field rheostat. Using the alternating voltage as a guide, he reduced it five volts by means of the exciter field rheostat.

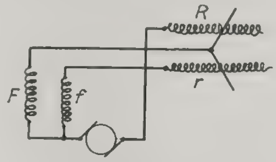


FIG. 2—WRONG CONNECTIONS

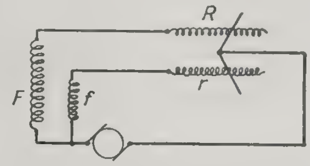


FIG. 3—RIGHT CONNECTIONS

On looking at the exciter voltmeter, he was surprised to find that its reading had increased 10 volts; on again raising the alternating voltage to normal by means of the exciter field rheostat, the exciter voltmeter indication resumed its original value. This behavior was so entirely different from what was to be expected, that observations were repeated several times. Any movement of the exciter field rheostat each time caused the alternating and direct voltage to vary in opposite directions. As the water wheel from which both the alternator and the exciter were driven had no governor, he thought that possibly speed variations might be responsible. That such was not the case, however, seemed to be proved by the fact that any change that was made in the alternating voltage when experimenting, was permanent.

Assuming that the series and the separately exciting field coils were opposing each other and that the series coils were so much the stronger that any change in exciter current was a change in the smaller of two opposing magnetizing forces, the inconsistent readings would have been accounted for, because:—

Increasing the exciter voltage would increase the exciter current. This would increase the opposition to the series coils which would still prevail in effect, and would also decrease the resultant flux and with it the alternating voltage. Decreasing of the exciter voltage, would decrease the exciter current, thereby decreasing the opposition to the over-strong series field coils. This would increase the resultant flux and with it the dependent alternating voltage. As the series field was then known to be weak owing to the multiple-series connection of its coils, the preceding explanation could not be applied.

The machine continued to run for several months more in that condition when occasion arose for making some changes in the switchboard lay-out and in order to do this it was necessary to practically strip the board. The man who did the work did not pay any attention to the connections because he knew how they should be. After the changes had been made and the machine and switchboard reconnected, the mysterious regulating feature had disappeared. The operator, however, compared the new connections with the original ones, which he remembered, and he found that all of the trouble was due to a wrong connection of the combination alternator-exciter rheostat. In Fig. 3 are indicated the connections as they should have been; in Fig 2 are indicated the connections as they were at the time of the irregular voltage actions.

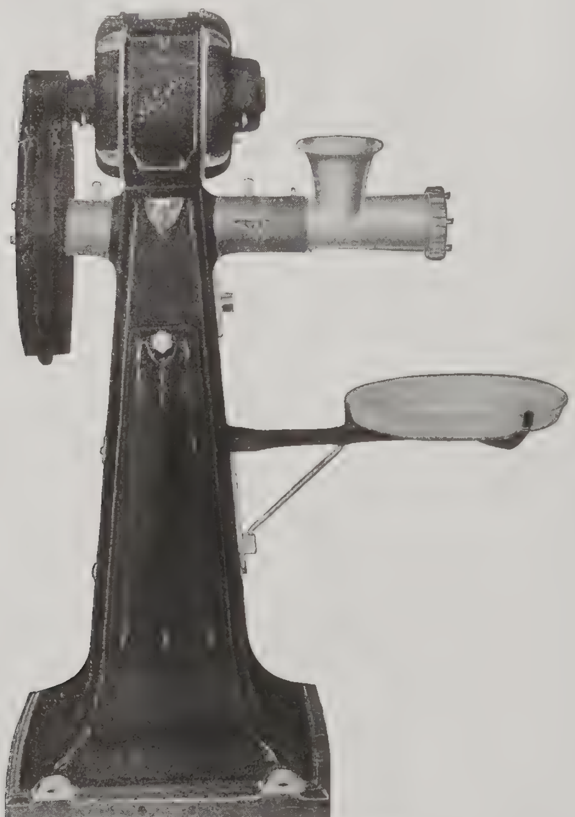
D. C. Motors.—The speed of a series wound motor depends on the applied load. With heavy loads the speed is relatively low and as the load is reduced, the speed at once increases. At no load, the motor will race or "run away."

Electric Chopper for Better Store Service

THE use of electrically-operated devices in the modern store, besides contributing to the appearance, does much toward increasing business by reducing the time required to make a sale. For instance, the electric meat chopper illustrated here, of the Hobart style, will chop over three pounds of beef per minute, whereas, with a hand operated chopper, the operation would require several minutes. Also, another can be served while the machine is doing the work. A ½-horsepower Westinghouse motor of special design is used; a snap switch on the device starts and stops the motor.

This machine is capable of performing a broad range of service. While intended primarily for meat chopping, the following attachments may be used:—grindstone for tool grinding; pulley for light work, such as kraut cutting and meat slicing; bone cutting to interchange with the chopper; and a grinder, making it suitable for coffee or pepper grinding. When used in a store handling both meats and groceries, these features are specially valuable.

Every progressive business man knows that a clean, up-to-date, attractive store is an invaluable asset, the possession of which aids considerably in building up store prestige in his community. While this is true to a certain degree of every business, it applies particularly to those lines in which the handling of foods is involved. The grocery store, the confectionery shop—all must be inviting or the public will go elsewhere.



AN ELECTRICALLY OPERATED MEAT CHOPPER WILL MODERNIZE ANY BUTCHER SHOP. ITS USE MAKES A BETTER STORE SERVICE POSSIBLE

Wiring Systems.—One of the main advantages in using the three-wire system lies in the fact that on account of the voltage being doubled with respect to two-wire distribution, then the wires can be of much smaller size for similar conditions.

Trouble Hunting.—While looking for circuit troubles always work according to a fixed plan; haphazard testing and guessing will usually waste time. In low tension alarm, signal or bell circuits, the most important thing to ascertain is whether the battery of the system is in working order.

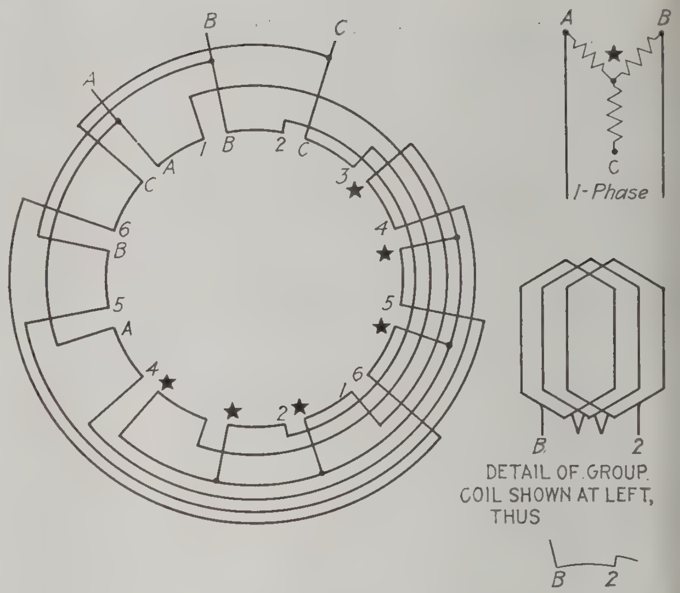


FIG. 1—FOUR-POLE 3-PHASE STAR ARMATURE WINDING

Armatures for A. C. Machines

PRESENT practice is to use 3 phase star connected machines for single phase using only two of the windings, or one phase. Fig. 1 shows a winding for such a machine. The winding itself is a plain lap winding with any desirable number of coils, say 3, to a group. The numbered arcs of circles on the diagram represent coil groups.

This winding would be used single phase by using any two of the leads A, B, C. One of the chief advantages of the three phase winding for single phase is that it permits the application of standard apparatus at a reduced rating.

If a special winding must be made it may be desirable to use a single phase concentric winding such as in Fig. 2. The oval loops represent coils which may have any number of turns. The stator shown is a 20-slot one and wound for 4 poles. The winding is shown developed pointing out that the first and last slots in the diagram are in reality, one and the same slot.—*R. H. Willard.*

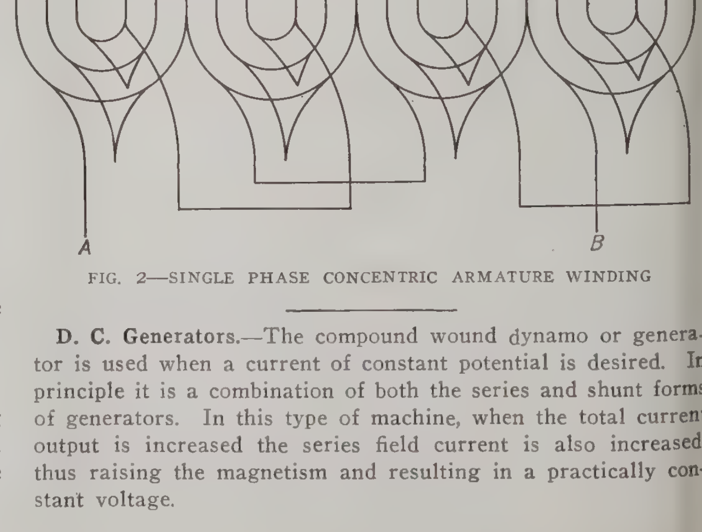


FIG. 2—SINGLE PHASE CONCENTRIC ARMATURE WINDING

D. C. Generators.—The compound wound dynamo or generator is used when a current of constant potential is desired. In principle it is a combination of both the series and shunt forms of generators. In this type of machine, when the total current output is increased the series field current is also increased, thus raising the magnetism and resulting in a practically constant voltage.

Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

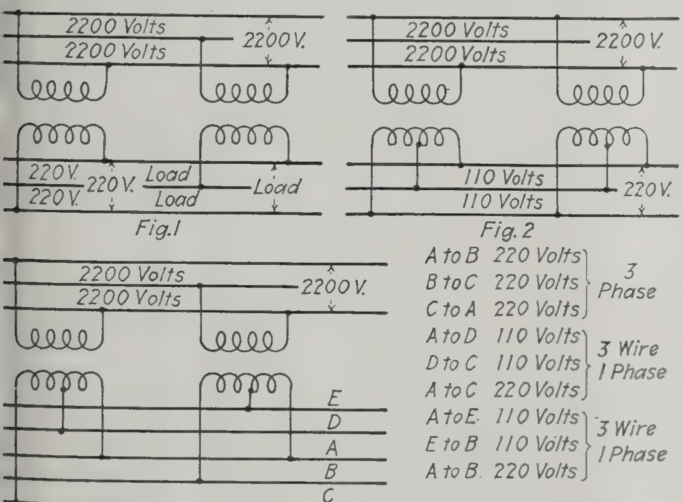
Single Phase From Three-Phase System

IN a three-wire 3-phase system with a 2200 volt primary, can two single phase transformers be so connected to give 110 and 220 volt secondary circuits with a resultant balanced load?

On account of the equipment available it becomes difficult to give a definite scheme for accomplishing the desired result, but the following answers may serve as suggestions:

R. H. Willard.—The first difficulty encountered is the requirement of balanced load. It is impossible to supply a single phase load from a polyphase system through any combination of stationary transformers and obtain balanced load on the polyphase system. One way of explaining this is that single phase power pulsates, i. e., the power supplied varies from zero to a maximum. Polyphase power supply is steady although the currents pass through zero points.

In order to change pulsating power to steady power a piece of rotating apparatus is necessary. If the load to be supplied consists of a number of small units it may be possible to place these on the different phases and secure more or less balance.

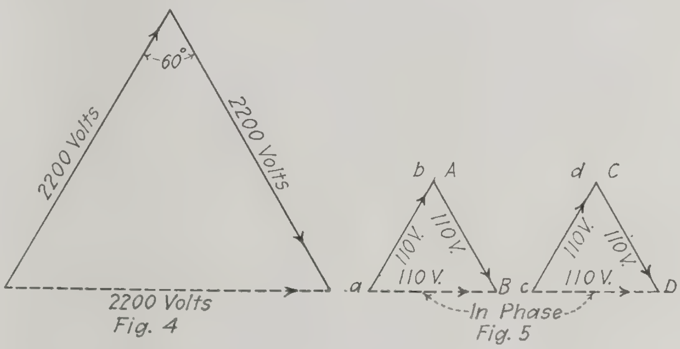


FIGS. 1, 2 AND 3—SINGLE PHASE FROM 3-PHASE

Connections for this condition would be as shown in Fig 1. This is a regular 3-phase V connection. If three wire 110-220 volt service is the most desirable part of the operation it will probably be best to put the transformers in parallel on one phase and put up with the unbalance. Fig. 2 shows this connection. Fig. 3 shows a combination which would allow of 3-phase motors on the 220 volts.

T. E. Tunison.—The desired results can be obtained by making use of a modification of the familiar open-delta, or V connection. With this connection the resultant voltage across the open side of the delta is equal to in magnitude, but displaced from in phase, in each of its components. This is evident from Fig. 4.

The primaries of the two single-phase transformers should be connected to the 3-phase system in the manner as shown by



FIGS. 4 AND 5—SINGLE PHASE FROM 3-PHASE

Fig. 6, but leaving both coils of each secondary winding temporarily open, i. e., for each transformer there would be four free loads, a, b, c, d, and a_1, b_1, c_1, d_1. The leads b, c, and b_1, c_1, are represented as being crossed inside the case, this being standard practice with distributing transformers.

It is now apparent that two entirely independent open deltas can be made up from the double secondaries on the two transformers. Fig. 5 shows the relations of these open deltas, both as to magnitude and also phase relation. The resultant emf is in each case 110 volts, and the resultants are in phase. These may be connected in series, giving 220 volts across terminals, and 110 volts from either terminal to the function point, from

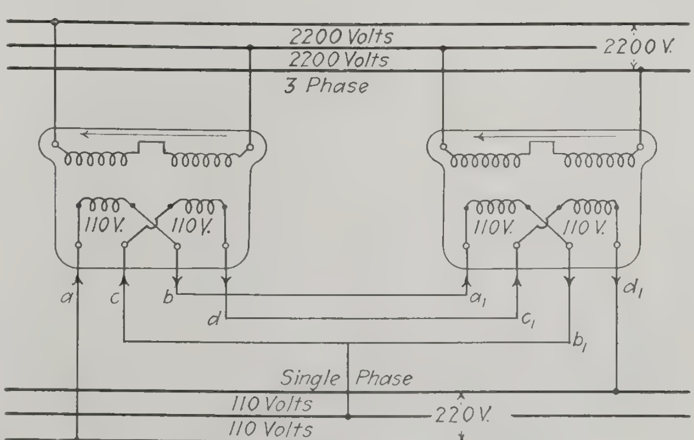


FIG. 6—SINGLE- PHASE FROM 3-PHASE

which the neutral of the 3-wire secondary is brought out. All these connections are shown in Fig. 6.

It would be well, however, to compare the connections as they are made and to ascertain if the resultant voltage across the open delta is in each case the same as the voltage of each of its components. This may be checked by means of a volt meter, or incandescent lamps. If one component or coil of the open delta is reversed, the resultant voltage will be $\sqrt{3}$ times 110 volts, or 190.5 volts. This is sufficient to cause a single lamp to burn out very quickly, so if lamps be used, two 110-volt lamps in series would be required. If, when the two complete open deltas are themselves tied in series, one delta is reversed, the total voltage across the combination will be zero instead of 220 volts.

If these connections are carefully made and voltages checked at each step, the two transformers should preserve an approximate balance on the 3-phase system, even when supplying a moderately unbalanced load on the 3-wire single phase secondaries.

The total capacity would be that of one transformer. Since the windings are all in series, the current capacity of one transformer cannot be exceeded, and the total voltage is the voltage of one transformer alone.

Henry A. Davis.—There is no possible way of taking a single phase load from a three phase circuit by means of two single phase transformers without unbalancing the three phase.

If the single phase load can be divided in halves a close balance may be obtained by using the connections shown in the diagram of Fig. 7. This connection also gives 3-phase 110 volts and 3-phase 220 volts. As will be seen leads a, b, c give 3-wire 110-220 volts single phase; leads c, d, e give 3-wire 110-220 volts single phase; leads b, c, d give 3-phase 110 volts and leads a, c, e give 3-phase 220 volts.

Discussion on the Protection of Transformer Windings

IS THE grounding of transformer cases a precaution only for safety of workmen or will such grounding prevent damage to transformers from lightning? This query was recently answered by an engineer, *K. R.*, as follows:

The grounding of transformer cases has been advocated solely as a precautionary measure against lightning. Connecting the lightning arrester to the transformer case, and grounding this latter is a most effective, and very inexpensive, method of protecting the windings of a transformer. The reason that it is not being done to a greater extent than it is, is on account of the life hazards that result. The close proximity of a grounded transformer case to where a lineman is working on a pole seriously increases the chance of accident.

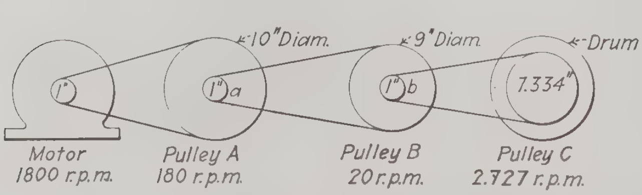


FIG. 1—PULLEY SIZES FOR A SIGN FLASHER

The object of protective devices is to prevent an excessively high potential existing between transformer primary and case and secondary winding rather than between primary and ground. By connecting the lightning arrester to the transformer case the transformer windings are protected to a much greater extent, although the potential to ground may be far in excess of normal. The grounded transformer case, and by that is also understood the connection of the lightning arrester to the transformer case, eliminates the deleterious influence of a high resistance ground connection, and the inductance of the ground wire still further assisting the protection.

Where lightning is severe it is advisable to ground the transformer case, and connect a lightning arrester on the same pole as the transformer. Linemen should be impressed with the importance of keeping clear of the transformer case under these conditions, especially when hiring new men.

Discussing the above, *C. A. Harmon* gives his views on the subject in the following terms:

It seems that the above ideas are just the reverse to those of most engineers. The writer cannot understand why connecting a lightning arrester to the transformer case or grounding the case would be any protection to the windings. It seems that a permanent ground on the case would be an invitation to lightning to puncture the insulation.

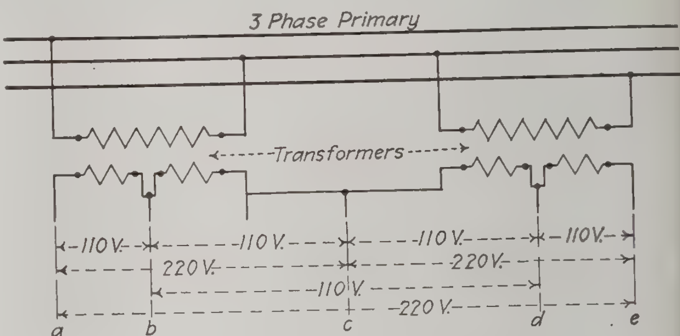


FIG. 7—SINGLE PHASE FROM 3-PHASE

Recently the writer had occasion to install several lighting transformers and did not ground the cases on account of lightning, and the only reason he would consider grounding them would be to protect any lineman who might come in contact with them in event of the insulation breaking down between the high voltage winding and case.

It would be of mutual interest to learn how grounding the transformer case would increase the life hazard, as stated by the first contributor, as no difference of potential could exist between the case and ground with the case permanently grounded.

Designing a Sign Flasher

THE data below will prove an aid in the construction of a flasher for an electric sign of the drum type and for the following conditions:

First flash to remain on 5 seconds; second flash to remain on 3 seconds; third flash to remain on 10 seconds and all to be off 4 seconds.

A. J. Kalinowski.—The sum of 5, 3, 10 and 4 seconds is equal to 22 sec., therefore it will take 22 sec. for each revolution of the drum, or $60 \div 22 = 2.727$ r. p. m.

Since the circumference of a circle is 3.1416 times diameter, we have the following lengths for the different contacts:

5-sec. contact$=5\div22\times3.1416\times$diameter.

3-sec. contact$=3\div22\times3.1416\times$diameter.

10-sec. contact$=10\div22\times3.1416\times$diameter.

The diameter referred to is that of the drum and can be made any convenient size.

Now, assuming a motor speed of 1800 r. p. m., which is a common speed for small motors, we have a ratio of $1800\div2.727=660$, in other words, the motor must make 660 revolutions to one of the drum. Of course this ratio will be different with different motor speeds, and can be found by dividing the motor speed by the speed of the drum, as shown above. All that now remains is to design a train of gears or pulleys to get the necessary reductions.

Assuming a motor speed of 1800 r. p. m. and its pulley of 1-in diameter, pulleys A of 10 in., B of 9 in., pulleys a and b

each 1 in, then pulley A will make 180 r. p. m. and pulley B 20 r. p. m. since the speed of two pulleys are inversely proportional to their diameters, or 1-in÷10-in=X÷1800 and X= 1800÷10 or 180 r. p. m. for pulley A. In the same way we find the speed of B will be 20 r. p. m. and the diameter of C to be 7.334 in. The drum revolves with pulley C. Of course any number of combination and sizes can be secured to give the same final speed of the drum.

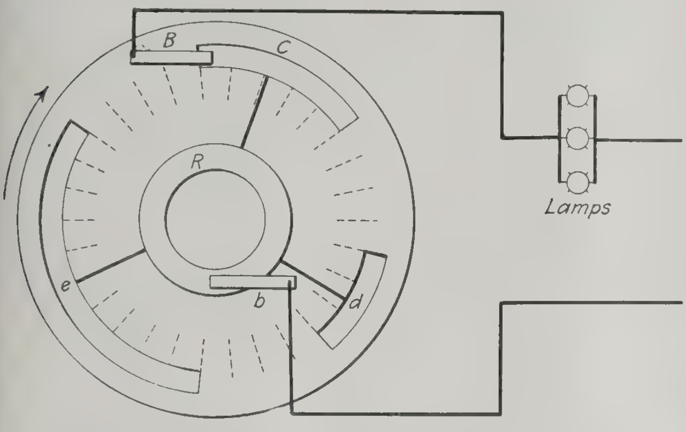


FIG. 2—ARRANGEMENT OF CONTACTS FOR SIGN FLASHER

Again assuming the diameter of the drum to be 10 in. we get the following lengths of contacts:

5-sec. contact=5÷22×3.1416×10 or 7.594 in.

3-sec. contact=3÷22×3.1416×10 or 4.284 in.

10-sec. contact=10÷22×3.1416×10 or 14.28 in.

Should a different diameter be chosen for the drum, use it as in the formulas above instead of the 10 in. assumed. The results of these computations are shown in Fig. 1.

Below are considered the factors which must be taken into account for the proper computation of the required contact strips for a sign flasher of the same type.

F. E. Austin.—If the writer understands the requirements, the first flash remains on during 5 seconds, then out during 4 seconds; second flash on during 3 seconds, off during 4 seconds; third flash on during 10 seconds, off during 4 seconds, and the cycle of events thus repeated.

The total time of one cycle of events is therefore 5+4+3+4+10+4=30 seconds.

If a drum or a disc revolves once in 30 seconds contacts may be arranged as shown in the diagram of Fig. 2. The disc or drum is divided into 30 equal spaces as indicated by the dotted lines. Sector d extends over 3 spaces, sector e over 10 spaces, sector c over 5 spaces, and there are 4 spaces between each sector strip. While brush b is in contact with sector strip d, the lamps will be lighted during 3 seconds; while the disc is turning at the rate of one revolution in 30 seconds, the time interval between contact sector d leaving the brush b and the contact sector c coming into contact with the brush b will be 4 seconds.

If the disc revolves faster than one revolution in 30 seconds, while the proportionate contact intervals and open circuits remain the same, each takes place in less time than when the disc revolves one revolution in 30 seconds. If the disc revolves at the rate of one revolution in 15 seconds, the lamps will be lighted 1.5 seconds due to contact d; out during a 2-second interval, lighted 2.5 seconds due to contact c; out 2 seconds, lighted 5 seconds due to contact e; out 2 seconds.

If the disc revolves at the rate of one revolution in 60 seconds, the cycle of events will be as follows: lamps lighted 6 seconds, out 8 seconds; lighted 10 seconds, out 8 seconds; lighted 20 seconds, out 8 seconds. This makes it evident that the speed of the drum or disc is the factor that regulates the length of contact. and not the size of the drum or disc. The contact drum or disc is usually rotated by reduction gearing from a motor pulley.

Different sizes of pulleys on motor shaft will produce different contact times, provided the speed of the motor remains the same.

Problems for Solution

The following are offered for your discussion. If you have information on these subjects or if you have had experience in these matters, then here is the chance for you to help those in difficulty. Published answers and discussions are paid for.

Lighting Systems.—In the diagram herewith is shown the 75-light rectifier sets now being used for arc lamp circuits. In changing from arc to tungsten lighting, would it be possible to use this rectifier as a constant current transformer by eliminating the tubes? If so, what connections should be made, give sketch of same. If not, give reason why.—*A. V. Wynne.*

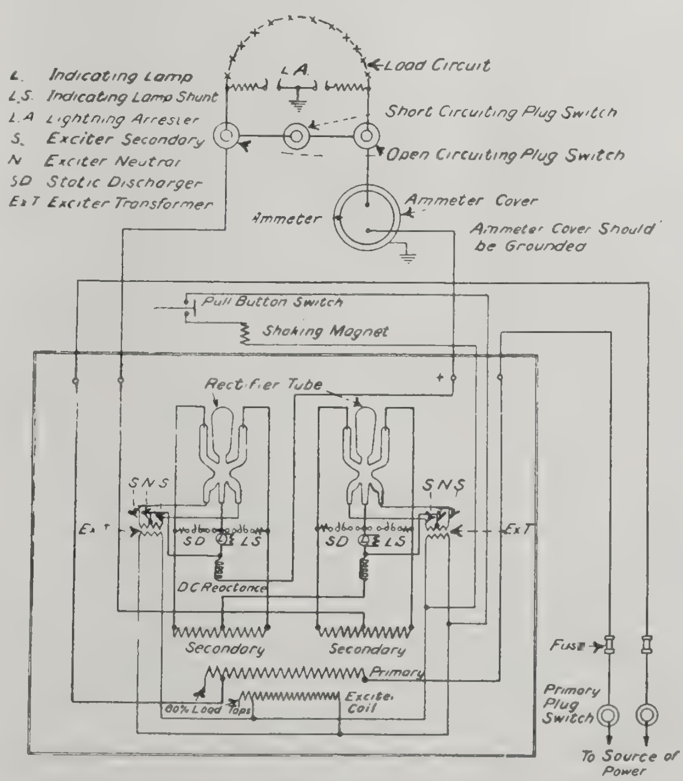
Operating Costs.—In a combined ice and electric lighting plant, the original cost of which is $20,000, the ice plant costing $15,000 and lighting plant $5,000, what would be a reasonable rate for depreciation as a fixed charge?

What percentage of the total cost would repairs to such a plant amount to each year and how should a fixed charge be calculated, starting with a new plant and running for 25 years?

What should be the overhead expense, labor, fuel (coal or oil), ammonia, oil, etc., per ton for operating a 25-ton ice plant, and what percentage of the total expense for each item?

What percentage of a 25-ton ice plant would it require to cool a cold storage room 10 by 30 by 12 ft.?

How many tons of ice are required for icing a fruit growers' express refrigerator car and what is the cost per ton for icing same?—*T. C. Metcalfe.*



CAN THIS DOUBLE TUBE RECTIFIER BE USED AS A CONSTANT CURRENT TRANSFORMER BY ELIMINATING THE TUBES?

Control for a Compound Wound Motor

THE following further discusses the various ways of connecting a starting box for the control of a compound wound motor.

H. D. Hopkins.—The diagram in Fig. 1 is correct either with or without the dotted connection X, as the starting resistances are small in comparison with the shunt resistance. In actual starting rheostats, the shunt field is connected through the no-voltage release to both ends of the starting resistances so that they are cut out when the handle is in the running position. This gives the full field current in the first position and prevents any unnecessary heating or possible damage when the handle is in the running position.

A. L. Gear.—The solid line connection as in Fig. 1, from the last button or contact point upon the starting rheostat is possible. All Cutler-Hammer starting rheostats now have a special contact button about midway between the hinge post upon which the sliding arm turns and the last armature resistance button. There is also a special spring contact midway of the sliding arm to press upon this button when the sliding arm is in motor full-speed position. The solid line connections from the first armature resistance button to the no-voltage release coil is very desirable. It prevents starting the motor upon a partially weakened field.

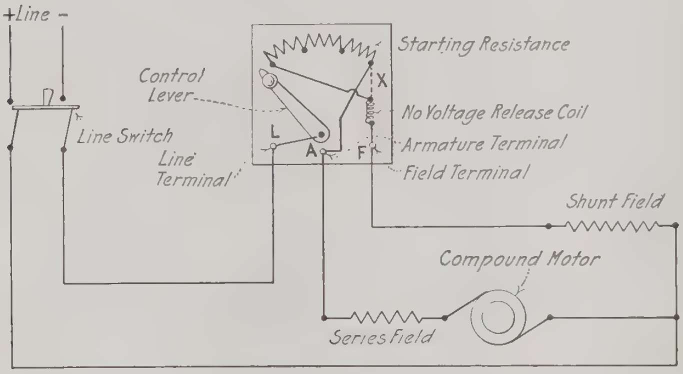


FIG. 1—CONTROL FOR COMPOUND WOUND MOTOR

An accumulatively connected compound wound motor will race upon a weak or broken shunt field, while a differentially connected compound wound motor will race in opposite direction upon a weak or broken shunt field. The connection referred to, being upon the first contact made by the sliding arm, immediately places the shunt field across full supply voltage, while if the connection from the first contact point to the no-voltage release were removed the shunt field coils would be in series with the armature resistance. This under very small or no-load may give no trouble but under conditions of fifty per cent, or one-hundred per cent. over-load may so heat the armature resistance that it would place a very considerable amount of resistance in series with the shunt field thereby making the motor start upon a weak field at greatly increased speed if it would start at all.

R. H. Willard.—The solid line connection shown in Fig 1, is correct. Changing the no-voltage release connection as indicated by dotted line X, would not be advisable. If this were done the connections would give relative values as in Fig. 2. As the figures show, the drop in the starting resistance is quite a large proportion of the line voltage at starting. This leaves the shunt field connected across a low voltage.

With a weak field it requires considerably more current for a given starting torque than with a strong field. If the motor has a heavy series field connected cumulative it might not make much difference but with a weak series field or a differential connection there would probably be a large rush of current on starting.

The writer connected a 1½-hp. shunt motor in this way and the lights dimmed noticeably every time the motor was started while a 5-hp. motor properly connected caused no flicker.

Wiring a House

IN the sketch herewith is shown a simple layout for equipping a house with an emergency lighting system. All individual control points must have a 3-way or three-point switch and connected in accordance with the diagram. Use a two pole master switch in the circuit at location where the emergency control is desired.

With this arrangement all the lights may be thrown on by the master switch. In practice the writer has found this layout the most satisfactory of several others he has tried.—*Darle Harter.*

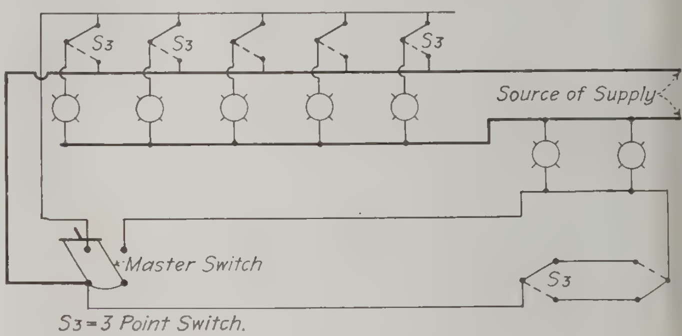


DIAGRAM OF HOUSE WIRING FOR EMERGENCY LIGHTING

Friction in Electrical Machinery

AN excellent way to test the friction losses in a motor is to run it "no load" at normal speed and then throw the switch. The stored energy in the rotor will cause the motor to continue to run for a few seconds or minutes. The longer the motor runs, the better.

All that is necessary for the performance of this test is a common watch. Note the time that is required for the motor to come to a dead stop. You will find that under similar conditions the stopping time will be the same every time; with added friction, the stopping time will be less. With friction conditions improved, the time in which the motor will come to a stop, will be greater.

It is therefore evident that for the attainment of greatest mechanical efficiency the stopping time must be made as long as possible.

This friction test can be utilized in many other ways. If the motor is heavy enough, for instance, to keep some of the machinery running for a short time even though it may have to be run empty, one can in the same way, determine whether the entire shaft transmission system is at its best or not. This applies particularly to belt and line shafts.

There are many details that must be observed in connection with this work to assure fairness or accuracy in the test, but they are so obvious that their enumeration is unnecessary. Any engineer of judgment will know what is proper and what is improper as soon as he catches onto the idea.—*N. G. Near.*

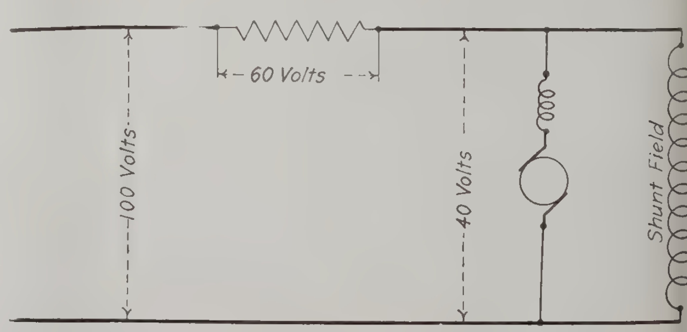


FIG. 2—CONTROL FOR COMPOUND WOUND MOTOR

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

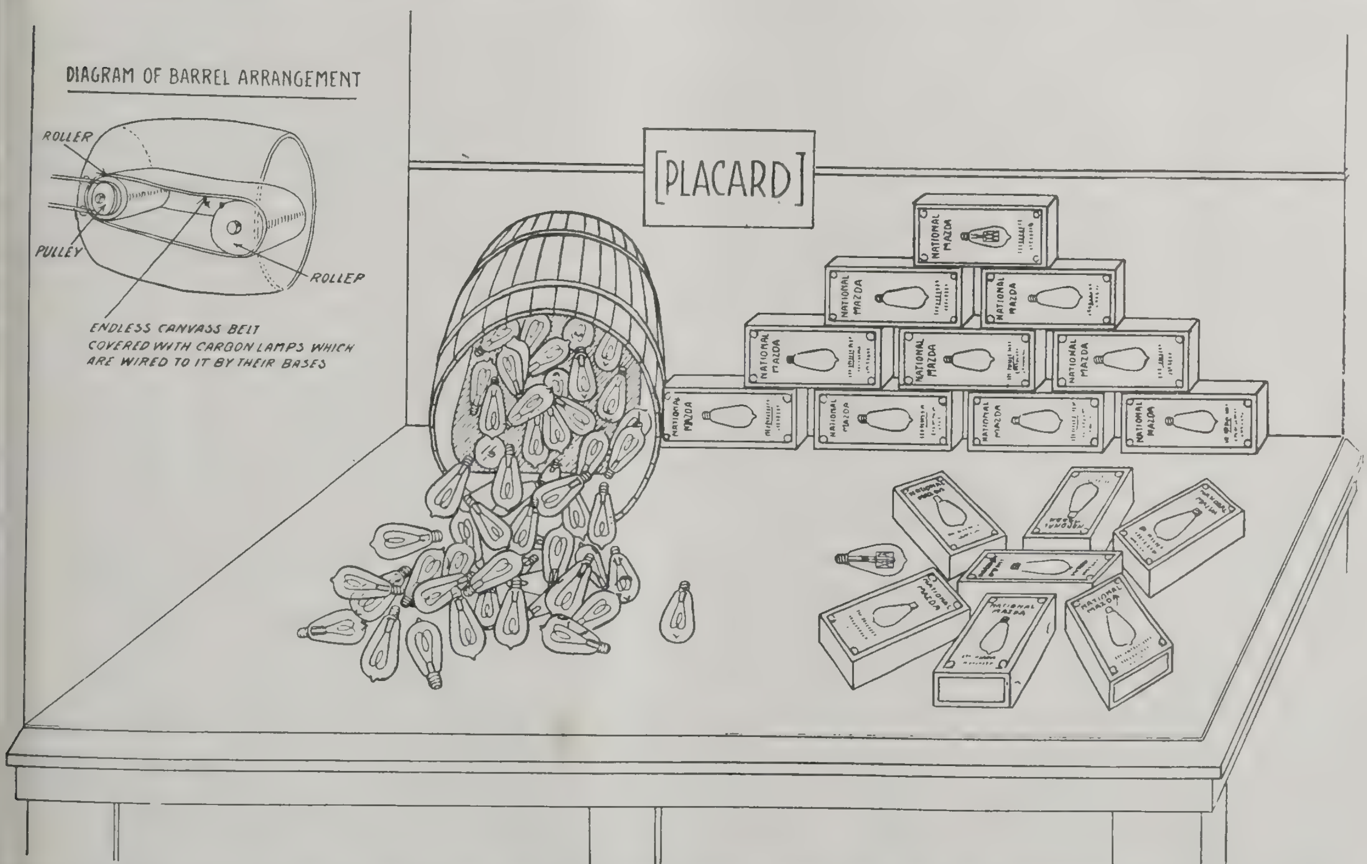
Unique Displays That Brought Results

HEREWITH are actual instances where striking window displays were the direct means of securing increased sales. The same ideas can certainly be applied to pecuniary advantage in any other locality.

The roulette-wheel arrangement, originated by Ernest Dahlheim, resulted in the sale of 70 cartons of lamps, or about a one-hundred dollar gross income for the first day the display appeared in the window. In the illustration the face of the dial has the appearance of a roulette-wheel, with the numbers ranging from 1 to 304. The hand or spear, and pegs are wired so that at every other peg the lights on the spear flicker first white, then blue, alternatively. On the back side and concealed in the sprocket wheel of the spear shaft is mounted a flasher of 6-in diameter operating to give an outward effect as though the lights were chasing each other, first blue and then white. A white background is used so that when the blue lights flash it appears as if a blue ball were going about and around the wheel. The spear is driven by a small motor geared down to make 4 revolutions per minuute.

An advertisement in the local papers called attention to the roulette-wheel and prizes shown in the window. With each carton or box of Mazda lamps sold, the purchaser was given any number he or she had selected from the dial. These chance tickets entitled the holder to the various prizes that were on display in the window.

Another display that was responsible for 150% increase in the month's sales of Sunbeam lamps, and a sworn affidavit is evidence to this fact, utilizes a barrel or nail-keg. R. B. Howard



THIS BARREL OR NAIL-KEG DISPLAY DEPICTS THE FOLLY OF USING CARBON LAMPS AND ADVOCATES THE MODERN MAZDA WAY. AN INCREASE OF 150% IN THE SALES DURING THE MONTH ARE ATTRIBUTED TO THIS ARRANGEMENT

of Hampton, Va., is the originator of the scheme. To the passer-by it appears that hundreds of carbon lamps are flowing in an endless stream out of a keg onto a scrap-pile. Mazda lamps and cartons with placards tell the rest of the story.

Secure a small nail-keg and cut the front out as shown in the drawing, then knock out the bottom and cut the same as the front. Place in these two open places a roller to come flush with the face of the keg, then place a canvas endless belt on the rollers, with a small power motor to run same.

Place, by wiring on around the base of each lamp, a good many old carbon lamps all over the belt. This is put in the corner of the window slightly slanting. Around the mouth of the keg put a good size pile of the old lamps, some broken, to make the scene more real. When the motor is started, it will look as if there is a continuous pour of the lamps out of the keg. Be sure there are a good many lamps on the belt to cover it. A sign may be placed on the top of the keg reading, "Count the number of old carbon lamps that are rolled out to the trash pile daily" and a small sign on the pile of lamps around the keg, some broken of course, "Safety First, break the old carbon lamps before they break you." Trim the rest of the window with mazada lamps and cartons with an appropriate placard.

Helping the Dealer Make More Lamp Sales

IN conjunction with the celebration of Edison Day, October 21 this year, the thirty-sixth anniversary of the invention of the electric incandescent lamp, October 21, 1879, by Thomas A. Edison, a nation-wide prize contest for boys and girls has been inaugurated by the Edison Lamp Works of the General Electric Company.

The contest will be carried on in co-operation with lighting companies and dealers all over the United States, and is for the purpose of extending the growing popular appreciation ot electric lighting and particularly the replacement of old style carbon lamps with modern types of Edison Mazda lamps. The contest opened 12:00 a. m., Tuesday, Sept. 21, and closes 12:00 midnight, Thursday, Oct. 21, 1915.

Thirty-three grand prizes and 2,000 smaller prizes amounting to $2,500 are offered, and the conditions are such that either boys or girls may compete with equal chances. The first prize for boys is a $275 Indian big twin motorcycle, and for girls is a $200 new type Edison diamond disk phonograph with $75 cash for records; the second prize for boys is an $80 Evinrude detachable rowboat or canoe motor, and for girls is an $80 order on any jeweler for a choice of jewelry; the third prize for boys is $47 Old Town "Octa" 17-ft. canoe, and for girls is a $47.00 Parisian ivory toilet set; and so on down through a long list of jewelry, musical instruments, cameras, sporting goods, etc., for the thirty-three prizes. Each of the 2,000 boy or girl contestants that stand next highest will receive an Eveready fountain pen flashlight. Each prize is not awarded to one boy and one girl contestant, but the first prize to one boy or one girl, and so on. The boy or girl winner also has the privilege in each case of accepting the cash equivalent instead of the prize.

During the month of September the Edison Lamp Works has conducted and will continue same during October one of the most comprehensive campaigns of propaganda ever undertaken on Mazda lamps, and for the purpose of popularizing electric lighting. Advertisements will appear in over 18,000,000 copies of 100 different magazines and newspapers circulating in practically every section of the United States. Numerous Sunday magazine supplements, the great weekly and monthly popular magazines, boys' magazines, and many trade and technical journals will carry their respective Edison Day announcements to the general public, to the boys and girls who should enter the contest and to their parents, to manufacturers, to business men, to stores, to central stations, to dealers, etc.

The entire campaign should result in a tremendous impetus in favor of electric lighting. The invention of the electric incandescent lamp by Thomas A. Edison is one of the world's greatest scientific achievements, and the development and perfection of this lamp to-day my be said to be one of its greatest industrial accomplishments. A broad national movement of this kind not only honors firstly the master inventor of one of the things that has increased so measureably the comforts of humanity, but it will also intensify the common interest of the electrical industry, public service and the general public.

THE FIRST DAY THIS ROULETTE WHEEL WAS MOUNTED IN THE SHOW WINDOW, TOGETHER WITH A DISPLAY OF THE PRIZES OFFERED, THE COMPANY SOLD $100 WORTH OF LAMPS

The Prominence of Electricity in Uncle Sam's War Plans

ELECTRICITY is being extensively employed by the United States Government in the national defence preparations now under way. The plans of the army and navy departments also call for its use as a destructive agent in the advent of hostilities. Of the electrical men involved the first expert appointed on the national defense board was Thomas A. Edison.

That many and various are the uses of electricity in modern warfare is conclusively proven by the European war. Not only as an invaluable industrial agent in the manufacture of munitions but as a potent factor on the battle field itself, electricity is being widely and successfully employed by all of the belligerant nations.

So that the American public may learn some of the uses which the United States Government is making of electricity in preparing for national defence, and some of the ways in which it will be employed in actual fighting on land and sea, in the air and beneath the waters, a series of exhibits have been arranged with the co-operation of Secretary of War, Lindsay M. Garrison and Secretary of the Navy, Josephus Daniels. These will be shown at the ninth annual Electrical Exposition and Motor Show, to be held in New York from October 6 to 16.

Under the direction of the War Department the Springfield Arsenal will show the manufacture of rifles, including the rifling of the barrels, turning of the stocks, and assembling of the guns. It will also show the manufacture of sabers, including the several operations from the blast furnace, to the finished product. The first Blanchard lathe made in this country in 1882 for turning rifle stocks will be shown. The signal corps of the eastern division of the army will have an exhibit of all communication apparatus used by a modern army in the field, including wireless telegraph, telephone and various signaling devices. The United States Navy has prepared by direction of Secretary Josephus Daniels, a kilowatt wireless sending and receiving station and the central generating station of a dreadnought. The work on these exhibits is being done at the New York Navy Yard.

What I Would Do

In Order to Profit by Electrical Prosperity Week

If I Were a CENTRAL STATION MANAGER:

I WOULD begin to plan right now some snappy, novel advertising "stunts." Of course, I would not neglect my present business-getting plans, but I would certainly plan something special for the big affair in November.

I am a great believer in demonstrations, especially during the Christmas shopping season. Indeed, it is fortunate that Electrical Prosperity Week comes at the beginning of this great merchandising period. Shoppers are attracted by demonstrations and they buy.

It might cost more money than I can afford to advertise a demonstration as effectively as I would like to, but I will use the newspapers for the announcement, anyway. Having segregated my city into districts and numbered each one, I would offer a prize of, say, $10.00 to the commercial representative securing the largest attendance to the demonstration for his own district.

I would work it somewhat in this manner: Monday I would assign to District One, the invitation card being green in color; Tuesday to District Two, the invitation card being pink, and so on during the entire *Week*, the color of the card and district being changed accordingly.

If I worked for a company in a small city I would modify the foregoing plan, but I would put on a demonstration at all events, and if I did not sell appliances I would put the demonstration on just the same and cooperate with the dealers. It's a good stunt.

Also, I would assist the contractors to install service in stores which haven't got it now, or to make present lighting systems more efficient. Electrical Prosperity Week is going to be a celebration—it can be made so everywhere—and merchants should have better than ordinary lighting to get the best results from their selling efforts. I would get busy with the civic organizations, such as the Chamber of Commerce, and tell the secretary (usually the live wire) all about the *Week*. I know they will receive me with open arms after they get the letter and literature telling them of the great trade campaign, which is being circulated by the *Society*.

I would plan right now to offer prizes to school children for the best essays on Electricity on what it will do. I would support the Electrical Page, if there is one in the local paper. Newspaper advertising will make more business for me.

There is one thing I certainly would do above all, that is to illuminate the front of my offices, as they have never been illuminated before. Then I would have an attractive show window, and keep the inside of the store well lighted, for if I did not keep my place lighted until 11 o'clock or later, I certainly would not be in position to ask others to do so. Yes sir, if I didn't do anything else, I would have my place of business a veritable blaze of light.

I would send in my order to the Society at once for a complete set of its splendid campaign advertising matter—nothing like getting it ordered well in advance. I would begin now to print the *Week's* design on my bills and on all my stationery. To try honestly, there are so many things I could do—that I can't begin to tell in this space all that could be done.

THIS "GODDESS ELECTRA" DESIGN IS THE RECOGNIZED EMBLEM OF THE WEEK

If I were a MANUFACTURER:

I WOULD write a letter to every last one of my salesmen, no matter where they were located, and tell them what Electrical Prosperity Week means to the industry. I would send this letter out from the home office and I would either sign it myself as the president of my company, or my sales manager would sign it.

This letter would urge my salesmen to hustle for business that is bound to come on account of the *Week*. I would fill it as full of ginger as I could. I would impress them with the importance of this national-wide campaign and the fact that it is the greatest trade movement in history. Then I would present some of the possibilities offered to "clean-up" and follow this up with other letters.

Then I would enclose little leaflets to jobbers, telling them how I was going to help the good cause along, and urging them and the dealers to work for and get benefits from the *Week*.

But here, I nearly forgot something that is more important, that is, mention the name of the *Week*, and print my membership emblem or the *Week's* design in all my advertising matter. In this way I would benefit from the nation-wide publicity the campaign is getting in newspapers and magazines everywhere. I would certainly

advertise in the electrical Trade Journals for this event if I never did it again thoughout the year, because the *Week* will surely benefit the manufacturer. Everything that is sold naturally has to be made, and therefore I would surely profit in any event.

If I were a JOBBER:

I WOULD urge my salesmen to think, talk and boost Electrical Prosperity Week. I would, through circular letters, and in every way possible, impress upon them the importance of promoting the success of this great campaign.

I would feature the *Week* in my house organ, if I had one, and I certainly would advertise it by printing the *Week's* design in all of my advertising copy, no matter where it was printed, and I would certainly advertise it in my electrical Trade Journal.

There are any number of ways I could help the retailers in conducting sales campaigns. I could get literature from the manufacturers which would boost the campaign along, and as this is a very especial occasion I think it would be a good idea to get up some special literature of my own, thus co-operating in the movement with profit to myself—and at the same time aid in the development of electrical products.

If I Were a DEALER:

I WOULD pay particular attention to window displays. The show window is the last link in advertising. It shows the prospective customer the article he has read about in magazines and newspapers. A well-lighted, attractive show window is certainly effective in selling goods—and it is really surprising how inexpensive it is to get up one.

I would begin to plan right now some special sales campaigns and emphasize the "shop early" idea for Christmas in all of my advertising, cards and publicity of every description. The *Week* comes at just the right time for this. I know of so many things I could do to profit that my field is really unlimited.

If I Were a CONTRACTOR:

I WOULD start right now to line up all the people of my acquaintance and make known to them what Electrical Prosperity Week stands for. I would figure out who should have their houses and places of business wired, and get busy to wage a special campaign for this business. I know my prospects will have their interest awakened by the tremendous publicity the *Week* is receiving. They will be in a receptive mood to install electric service, or add to their present system.

I would get busy with the secretary of the Chamber of Commerce, tell him what the *Week* means to our City, to the people of the whole country, and how better lighted streets and stores will help this City to prosper. No one likes a dead town. Electric signs have changed ten o'clock towns into twelve o'clock cities. The electric sign business, as a consequence of this campaign, is going to make some money for contractors—and sign manufacturers, and I would certainly get in on some of it.

The display men in the department stores and similar establishments would aid me to install better window lighting when necessary, for I would have knowledge that the International Association of Display Men—2,500 strong—are back of this movement. They are boosters for the better lighting—and they'll get it. I would want to be the contractor to get the business.—Suggested by *Society for Electrical Development.*

A Canadian Method of Increasing Current Consumption

In certain Canadian cities the public utilities commissions are giving electrical cooking lessons for the benefit of local consumers of current. It is hoped in this way to bring about such a demand for electricity for cooking as to warrant the making of a special cooking rate. At Ft. William, Ont., where such a school has been in operation daily for some time, there is a complete installation showing the cost of each individual cooking operation. Afternoon tea is served to visitors. Local dealers in electrical goods have been invited to make a display of their goods at the school.

It is pointed out that it would not be economical, under prevailing Canadian rates, to pay for electricity for cooking the same price that is paid for electricity for illumination; and yet, until a considerable number of Canadian housewives indicate a preference for cooking by electricity it will not be feasible to order a reduction in the price of current.

The experiment at Ft. William and other Canadian cities is being watched with a good deal of interest, not only in Canada, but also in the United States.

Electricity, it is pointed out, has made perhaps greater headway in Ontario than in any other place in North America. Not only are the cities and towns using it, but it has been carried to the farmers, who in larger numbers every season are using it for general power purposes in their daily work.

A Free Lunch Scheme that Worked

When Holstein, Iowa, decided to have a safe and sane "Fourth" celebration, Mr. Trauerman, manager of the Holstein Service Company, whom the *Western Electric News* reports as one of the company's livest agents, heard Opportunity knock and acted. In one of the town's most conspicuous centers he had an open booth erected and decorated with appropriate bunting and flags. An ice box, table and electric stoves were placed in the booth presided over by two white aproned attendants. Vacuum cleaners, fans, toasters and washing machines completed the display. The electric stoves were put to work, and light lunches were served. During the day they served 500 free lunches, and sold 12 electric ranges, various small appliances and took several contracts to wire houses.

Instrument transformers.—Current and potential transformers have one terminal painted red so that station men may readily connect them in circuit and have them right as to polarity. If this precaution is disregarded in use and the transformers should be connected in parallel or to polyphase instruments there would be a short circuit or incorrect operation of the instruments.—*E. S. Ford.*

Temporary short circuits.—If you experience trouble due to the opening of circuit breakers on temporary short-circuits do not remove the over-load tripping device on the breakers as an easy way out of the difficulty. If the over-load trip is removed, one is likely to have more grief than the repeated closing of circuit breakers; the generator would be apt to burn out or other trouble would show up when temporary short circuits would occur. The logical thing to do is to remove the cause of the shorts as far as it is possible to do so.—*Ernest S. Ford.*

New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

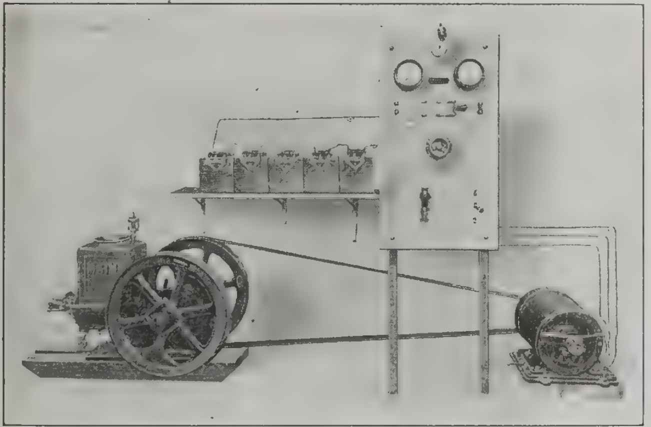
Lighting The Isolated Country Home

Even in the sparsely settled sections of the country where there are no electric service companies to fulfill the demands of the few residents, it is still realized that electricity for lighting and power purposes is the cheapest, and certainly the safest method that can be resorted to.

How to meet this widespread recognition is not a difficult problem when the storage battery is considered. The Main Electric Mfg. Co., of Pittsburgh, Pa., have recently placed on the market several types of compact storage battery plants for such purposes. The Junior outfit will carry the full load of 12 lights for several hours. It is complete in every detail, as illustrated, being equipped with storage battery, gasoline engine and a Vermont Blue marble switchboard.

The switchboard is mounted on angle irons extending 60 inches high and is equipped with large standard meters, switches, automatic circuit breaker and controlling rheostat. The price of the various size plants are certainly low, especially when the high grade quality of the material is considered.

This feature places the use of such plants within the reach of all who want better lights at the lowest cost of operation. The cost of installation is lower than any other system of an equal number of lights.



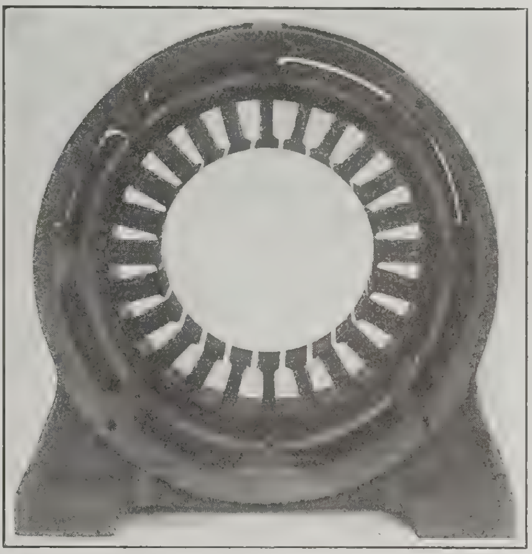
ONE OF THE MAIN STORAGE BATTERY PLANTS

Polyphase Induction Motors

An entirely new line of polyphase induction motors of the squirrel cage type, just placed on the market are of design shown in the illustration. These, it is claimed, have structural, electrical and patented ventilating features which make this line highly desirable.

The yoke itself, as will be noted, is of the skeleton type and cast from gray iron to give maximum strength and rigidity of construction. The end bonnets are of the same material and designed for ample ventilation. They are interchangeable and so drilled in relation to the yoke as to permit of rotation, thus providing for wall, ceiling and floor mounting. The interchangeable bearings are comparatively large in proportion, and are provided with ring oilers of large diameter, thus insuring a low rotative speed of the ring and preventing a churning throwing of the oil.

The Stator and Rotor Cores are built up of annealed laminations of a special grade of electrical sheet steel, insuring a minimum of iron losses. The assembly of the laminations is secured by heavy cast iron for the stator, or steel for the rotor, and end plates, all parts being carefully keyed to the yoke housing and shaft respectively. Shafts are made from a special grade of mild steel, provided on each end with a liberal oil sling turned integral with the shaft.



STATOR OF THE DIEHL INDUCTION MOTOR

The stator windings are first partially formed and shaped and then inserted into the heavy insulated semi-enclosed stator slots. This applies to all motors up to 20 h. p. inclusive. For sizes above 20 h. p. open slots have been adopted, permitting the use of a coil completely formed, insulated and impregnated prior to placing in the slots. The finished stator is finally subject to two dippings and bakings in an insulating compound of proper grade to insure a thorough impregnation, filling and sealing all insulated material. The above air gap spacings were finally adopted with due consideration to and correlation with the distance between bearings for the respective frames.

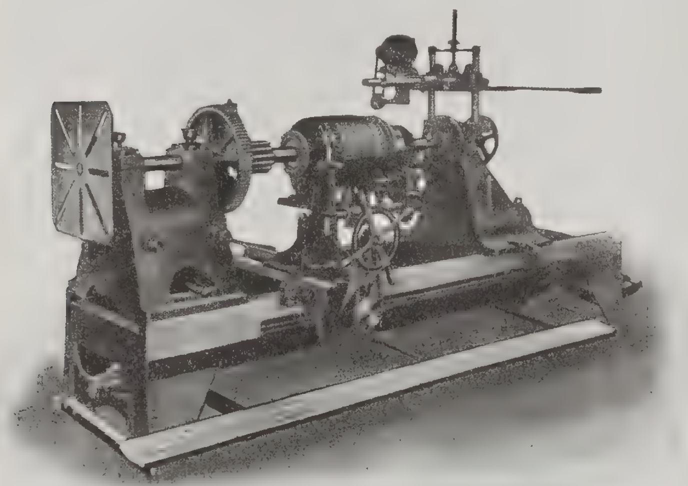
The rotor winding is of the regular squirrel cage type. After riveting is completed, the entire mass is dipped into hot solder of a very high melting point which penetrates all recesses, completely covering the end rings and ends of the rotor bars, preserving the electrical contacts from any possibility of corrosion. Each 3-phase motor is provided with six leads and each 2-phase motor with four leads, each of which is brought out through a heavy pressed steel terminal box. Soft rubber insulating bushings are provided for each lead.

Motors of this description are made by the Diehl Manufacturing Co., of Elizabeth, N. J.

A Heavy Duty Armature Machine

The armature machine illustrated is complete in every respect consisting of a banding machine for handling from the lightest to the heaviest railway motor or locomotive armatures, and having a self-contained tension carriage for band wire; a commutator slotting machine with independent motor; a commutator truing or grinding attachment with independent motor, and a field armature coil plate mounted on the main spindle suitable for all classes of form coil winding.

The commutator slotting attachment is supported from a bracket of the tail stock and is removed by loosening two cap screws. Two vertical rods support a casting, from which two rods project over the commutator. These two rods carry a sliding head on which is bolted the bearing for the milling saw arbor and on top of the sliding head a ⅛ h.p. motor is



PEERLESS HEAVY DUTY ARMATURE MACHINE

mounted for driving the saw. The casting supporting the projecting rods is adjustable vertically to suit different diameters of commutators and to regulate the depth of the saw. Provision is made to skew the travel of the saw in order to follow the mica slots when same are out of line. The sliding head carrying the saw i smoved across the commutator by means of a lever, which can be adjusted to suit its length and for the convenience of the operator.

The commutator truing or grinding attachment consists of a traveling grinding wheel, from which the tail stock is direct motor driven. Two steel rods project backward from the tail stock, and sliding on these rods is a casting which supports the two rods carrying the grinding wheel and a ½ h.p. motor, parallel with the face of the commutator.

A coil winding plate is mounted on one end of the shaft and is arranged to take all standard sizes of armature and field coil forms. As its speed is under instant control of the operator, it is suitable for all classes of work from the lightest to the heaviest.

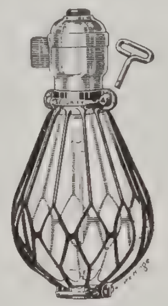
The machine is of the Peerless heavy duty type and is being exclusively sold by the Electric Service Supplies Co., Phila., Pa.

Lighting Fixtures

Some of the more recent lighting fixtures include such as the "Amcolight" line which the Art Metal Manufacturing Company of Cleveland, O., is getting out. The plates are made of sheet metal in dead flat white enamel that matches the satin finish of the glass globe. This globe is of special design. The chains and rings are white enameled and a heavy strap is furnished for hanging. Mogul sockets are provided and are adjustable; the fixture is complete and ready to install except for the lamp and wiring.

A Novel Fuse Plug

The Atlas Selling Agency, Inc., New York, is marketing a "Six-in-One" Fuse Plug. The plug contains six chambers for six separate fuse wires. When one of the fuses burns out, it is necessary only to pull slightly on the upper part of the plug which stands under the pressure of the spring and turn the part to the right. The new fuse snaps in at once.



SECURITY LAMP GUARD MADE OF EXPANDED STEEL

SIX-IN-ONE FUSE PLUG

Security Guard for Lamps

An expanded steel lamp guard is the latest device to be put on the market. This is for use with incandescent lamps, is made of steel well coated with tin, is light, strong and thoroughly protects the lamps from breakage. The hinge shells close with special design key screws to a rigid grasp on the socket. Thett is prevented; no tool but the special key will open the guard. The guards are easily adjusted; there are no wires to spring or bend. The halves swing outward from the hinge at the base. These Security guards are manufactured by the Flexible Steel Lacing Co., of Chicago.

THE INEXPENSIVE "AMCOLIGHT" FOR GAS-FILLED TUNGSTEN LAMPS

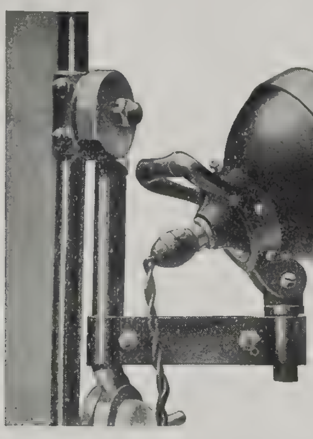
Searchlight with Outside Focusing Adjustment

A new automobile searchlight, known as the Pittsburgh "Five," is provided with an outside set screw focusing adjustment, which permits the use of any style lamp, tungsten or nitrogen, regardless of size or voltage, and makes it possible to adjust the lamp instantly for any kind of beam without disturbing it in any way or removing it from its position.

Due to this accessible adjustment, the lamp may be transferred from one car to another of different voltage at will. It also enables the user to select a bulb to suit his requirements, and in case of accident to use any available bulb as a renewal. Should it become necessary to use the searchlight to take the place of the headlight, the width of the illuminated field can be increased as desired.

Another feature of the Pittsburgh "Five" is the double curvature parabolic reflector which though only 5 inches in diameter, produces as much beam candle power as any large automobile headlight, with even distribution of light.

This lamp is manufactured by the Pittsburgh Electric Specialties Company, Pittsburgh, Pa.



THE PITTSBURGH SEARCHLIGHT

Mercury Arc Rectifier for Charging Batteries

A new and inexpensive mercury arc rectifier is just being marketed by the General Electric Company for charging small storage batteries, such as are used for starting, lighting and ignition current in gasolene automobiles and motor boats; for operating electric bells; for electro-plating; and for numerous other uses where not over 5 amp., 15 volts direct current is required and only alternating current is available.

The new rectifier consists of a metal base, on which are mounted the necessary reactance coils and the rectifier tube in a suitable cover, the whole being encased in perforated sheet metal. It is designed for charging one 3-cell, one 6-cell or two 3-cell batteries as required, and is automatic in that it is self- adjusting to any of these three conditions. In fact, the rectifier may be connected to a single-cell battery and will charge it at the rate of approximately 6 amp. from 110- volt, a-c. supply.

This type of rectifier can be furnished for 60, 50, 40, 30 or 25 cycles, 110-volt circuits. It is exceedingly compact, the outside dimensions being roughly: width, 6½ in.; depth, 9½ in.; and height, 11 in. The total weight of the 60-cycle rectifier is approximately 15 lbs.; therefore, it may be transported from place to place in a garage, rendering unnecessary the removal of the battery from the car.

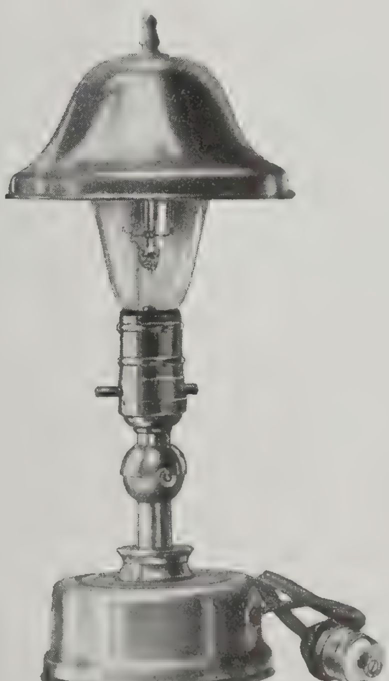
The rectifier is completely self-contained and requires no machanical ability either to install or operate it. It is so designed that it will maintain a fairly constant current as the voltage of the battery rises. It is very easily started, simply by screwing the flexible lead attaching plug, with which it is furnished, into any convenient alternating current lamp socket and connecting the two binding posts, distinctly marked plus (+) and minus (—), to the corresponding terminals of the battery to be charged. After the a-c. current supply has been turned on by the socket switch, the rectifier should be tipped slightly by means of the handle on the top. The mercury arc will then start; alternating current will be converted into direct current; the battery will begin charging, and the apparatus will require no further attention until the battery is entirely charged. Where two batteries are to be used, they should be connected in series and the terminals from the rectifier attached to outside posts of the two batteries.

The cost of charging either a 12-volt (6-cell) or two 6-volt (two 3-cell) batteries, for a 10-hour charge, is about 13 cents; or the same for a single 6-volt battery. This cost is based on a rate of 10 cents per kw.-hr. for current.

Portable Electric Lamp

The many novel features of the new Vanitie portable electric lamp make it a very attractive holiday specialty. A felt-lined clamp that pulls out of the base allows it to be securely fastened to a chair, dressing table, bed-post, sewing machine, etc., and a rubber suction cup concealed within the base fastens it to any smooth, polished, non-porus surface. This suction cup has an automatic release, enabling the user to destroy the vacuum instantly when desirous of moving the lamp from its position. Its adjustable and detachable shade fits any style or size of globe and can be turned to practically any angle to insure proper concentration of the light; the inside of the shade being coated with satin-finished aluminum. The visor joint permits of free movement in every direction and is so constructed that the insulation is protected at all times. Ten feet of high-grade parallel cord, wound inside of the base of the lamp can be drawn out so that only the amount in actual use is exposed. The Vanitie is constructed of high-grade brass throughout and is finished in old brush brass and heavy nickel plate. The height when standing erect is 12 inches; the weight 1½ pounds, and being so light is easily packed for traveling.

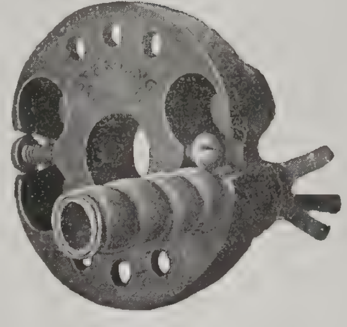
Manufactured and distributed by the Aladdin Lamp Corporation, 54 Vanderbilt Avenue, New York.



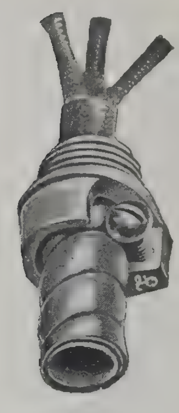
THE NEW VANITIE PORTABLE LAMP

Outlet Plate and Connector

The Sterling Foundry & Machine Co., of Newark, N. J., are bringing out an outlet plate and connector with an interesting clamping feature. The clamping of the armoured cable is by means of the direct grip of the head of a case hardened screw. The cable is easily inserted as there are no loose clamp pieces to interfere. This outlet plate—the Sterling Bi-plex—is made in the usual combination and straight electric styles. The combination is made to fit drop elbows without reaming. The connector is known as the Hexcel.



OUTLET PLATE



CONNECTOR

STERLING FITTINGS

Electrostatic Potential and Synchronism Indicators

Electrostatic vacuum glowers are now being used to indicate the presence of potential on high voltage a-c. circuits, and to determine when such circuits are in synchronism and may be thrown together.

For indicating potential, two appliances have been developed by the General Electric Company. The first consists of an electrostatic glower, a metallic condenser hood, a switch for cutting the glower in and out of circuit, and a hook for suspending the indicator from the line and leading current to the glower. One terminal of the glower is connected to a spark gap and then to the lower end of the suspension hook; the other terminal, to the condenser hood. The loop in the suspension hook enables the indicator to be hung over the line by means of the ordinary type of switch hook used for operating disconnecting lever switches.

The second form of indicator mentioned, is essentially the same as just described, except that no switch is provided and the hood is attached to a long wood rod equipped with a ground cone for connecting a wire between the rod and ground. The upper terminus of the lead running down to the spark gap inside the hood is connected to another lead going to the top of the pole to a metal pin, which is held against the line to determine whether the line is alive. This indicator is, because of its easy portability, most suitable when the indication of potential may be desired on a number of lines.

In using an electrostatic indicator, one should always bear in mind the fact that, although the lighting of the glower gives a positive assurance of voltage on the line, the lack of glow does not by any means prove the line to be dead, because the bulb may be broken, the loads disengaged, the potential too low, etc.

The usual method of indicating when a-c. lines or machines may be thrown together is by the use of synchronism indicator and synchronizing lamps, or by either the indicator or lamps separately, employing also as a rule the potential transformers that are used in conjunction with the meters or instruments. This arrangement is entirely satisfactory; but when it is desired to connect systems where transformers are not needed for indicating or measuring purposes, the equipment is comparatively expensive. The higher the voltage, the more does this apply.

The electrostatic synchronizer, as manufactured by the General Eleceric Company, requires for operation, however, only the charging current of the line. It consists of a few simple and inexpensive parts, and can be used to considerable advantage in main stations where current is metered on the low side, in switching stations, line junction stations and some substations.

Three electrostatic glowers, mounted in a case, which resembles that used for a round pattern switchboard instrument, are used for each synchronizer. The glowers are connected to the line through condensers consisting of suspension insulators, the insulating value of which is at least equal to that used for insulating the line.

The synchronism indicator can be used as a ground detector by connecting one terminal of each glower to the ground and the other terminals to the line. A lighted glower will indicate that the line is at potential above ground; i.e., not grounded.

Some Lighting Specialties

Harvey Hubbell, Inc., Bridgeport, Conn., have recently added to their Plug line, two caps in which the distinctive feature is a unique type of cord-strain relief which eliminates the need for knotting the cord and therefore produces a quicker assembly and a more durable combination. Fig. 1 shows an exploded view of the new cap that has standard contacts. At the top of the cap is a threaded ring which swivels around a split bushing that grips the cord when the ring is screwed into the depression in the upper end of the cap. The cord is first passed through the outer ring and its ends connected to the binding screws inside the cap. It is then drawn taut, the split bushing applied and the ring screwed about the bushing into the cap. This firmly clamps the cord so that the strain of pull on the cord does not come on the binding screws, and the likelihood of a wire thereby breaking connection is eliminated.

These new caps may each be provided with a special strain-relief bushing adaptable to armored cable. These caps are interchangeable with the entire line of Hubbell wall and flush receptacles equipped with 'T' slots, also with the respectively corresponding separable attachment plugs. The cap shown in Fig. 2 has the small-type contacts. This view shows the compactness of the completed cap with the bushing and threaded ring in place.

FIG. 1

FIG. 2

FIG. 3

HUBBEL SPECIALTIES

Added to this line also is a new outlet box receptacle, designated as Fig. 3. This device provides a very simple and compact means of connecting extension cords to conduit outlets. The receptacle has the new Hubbell T-slot, contacts, which make it interchangeable with seventeen different types of caps. The device is readily attached by clamping the outlet box cover between the upper and lower porcelain parts by means of a center screw which is threaded through both of them. A leather washer is included between the top porcelain and the outlet-box cover to take up any variation in either the porcelain or the cover. It also prevents the plug from rotating as the result of vibration. This method of attachment does away with the needs for drilling and tapping holes in the bottom of the fitting.

These receptacles are so designed as to be used with a variety of standard outlet-boxes and conduits of various manufacturers.

TRADE LITERATURE Catalogs and Books

A Complete Review of the Latest Publications

Handy Electric Wiring Devices is the name of catalogue 23 just issued by Pass & Seymour, Inc., of Solvay, N. Y. It is replete with information and illustrations on sockets, receptacles and such other wiring appliances. Copy of same may be had free on application to Pass & Seymour.

Direct Current Motors of the Commutating Pole, Type D—Constant Speed are fully described in catalogue 1000 of the Eck Dynamo & Motor Co., Bellville, N. J. Table of sizes and speeds give the details of this new type D motor. Copies of this bulletin may be had free by applying to the manufacturer.

Rubber Covered Wires and Cables are treated in the book of Standards issued by the Underwriters' Laboratories, Chicago, Ill. This work presents the results of extensive tests and examinations carried on by the Laboratories at many factories in the United States and Canada engaged in turning out wires and cables for electrical use. This book, also, has a supplement giving data from several thousand tests in Chicago and New York stations of the Laboratories on factory, market and field samples.

Small Electric Light and Power Plants are described in the new 80 page catalogue issued by the Main Electric Manufacturing Co., Pittsburgh, Pa. It describes in a non-technical manner the adaptability of electricity to the country home by the use of storage battery plants. It also lists various appliances and apparatus that may be used in conjunction with same. Those who are interested may obtain a copy of the above by applying to the manufacturer.

Truing Devices for use in Commutators are listed in a catalogue issued by Jordan Bros., New York. The various devices shown are intended for truing of commutators without removing the armature from generator or motor and these are made in various sizes. Catalogue is fully illustrated and should be in the hands of operating men. Free copy may be obtained upon application to the makers.

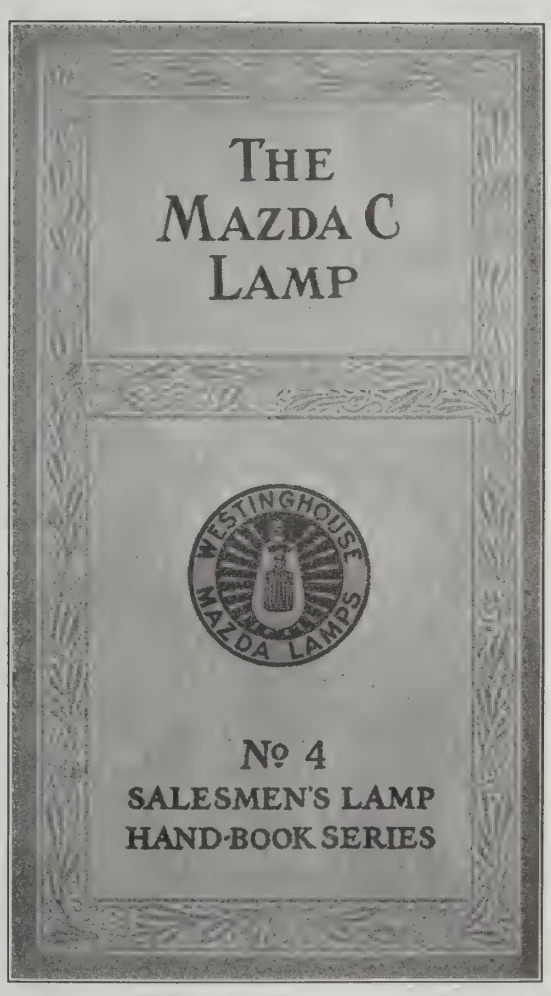
A leaflet from the Capital Electric Co., Chicago, Ill., describes and illustrates the Baby Geyser electric washer. This is a compact equipment which may be placed even in the bathroom of the house.

Hand-Book on Nitrogen Lamps. The Westinghouse Lamp Co., New York, have been issuing from time to time a series of instructive booklets designed to serve the purpose of electrical salesmen. These treat of the subject of Mazda Type C lamps from a non-technical standpoint and at the same time go into sufficient detail to explain the entire development and application of the lamp. Copies of these hand-books can be secured by application to the manufacturers.

Several leaflets descriptive of lock-sockets, sign receptacles, attachment plugs and similar devices have been received from the Best Electric Co., Pittsburgh, Pa.

A neat booklet on High Speed Steel Tools and Special Alloy Steels has recently been issued by the International High Speed Steel Co., Nassau St., New York. This gives the numerous applications of the various grades of steel in different forms and it also describes the hardening and tempering processes. Interesting data and handy tables are also included.

Internally Fired Water Tube Boilers are described in Bulletin No. 2 of A. D. Granger & Co., New York. These are known as the "Oswego" type and their details of construction, together with tables of sizes corresponding with capacity are well treated. Manufacturers will be pleased to send a copy of this catalogue to those who write for same.



COVER OF THE LAMP HANDBOOK

The application of disconnecting switches are featured in Bulletin No. 70 of the Minerallac Electric Co., Chicago, Ill. In this catalogue is described a new form of balance disconnect switch. Due to its construction no expensive frame work is necessary and insulators are eliminated. Copies of this bulletin may be obtained from the manufacturers.

Friction Tapes, Insulating Compounds and other moulded rubber goods are listed in the catalogue of the Massachusetts Chemical Products Co., Walpole, Mass. The company will be pleased to send a copy of this catalogue on application.

An interesting leaflet describing tests on insulators has recently been issued by The R. Thomas & Sons Co., East Liverpool, Ohio. Copies of this bulletin will be sent gratis if requested from the manufacturers.

Electrical Measurements and Meter Testing by Prof. D. P. Moreton is a new book published by Fred. J. Drake & Co., Chicago, Ill. The facts presented are in plain English and in the opening treats of the fundamental principles of electricity. The remaining chapters deal with electrical measurements and the construction, operation and calibration of the instruments used in making such measurements. The fundamental theories are clearly presented, practical applications are shown and numerous examples and their solutions are given. The book is thoroughly illustrated. It is of pocket size, contains 328 pages, 191 illustrations and reference tables. Limp cloth, price $1.00; full leather binding, $1.50.

Examples in Alternating Currents by Prof. F. E. Austin, Hanover, N. H., has recently been published by the author. The book tells just what you need to know regarding the solution of a. c. problems and gives examples which are fully worked out step by step to show process of solution. The make-up of the book is unique, the text being printed in green ink. Numerous tables and diagrams form an important and

Eye Protectors is the name of a catalogue issued by the American Thermo-Ware Co., Warren St., New York. This lists various forms of glasses to be used as a safe-guard for the eyesight made necessary by industrial operations.

Facts relating to enclosed fuses are given in bulletin recently issued by the D. & W. Fuse Co., Providence, R. I. Interesting data included in this pamphlet should make it worth your while to send for a copy of same.

Bulletin No. 253 of the Bureau of Standards treats of the direct reading devices for computing characteristics of vacuum tungsten lamps and it includes a computing chart. It is replete with technical data as arranged by J. H. Skogland. Copies of this paper may be obtained upon application to the Director, Bureau of Standards, Washington, D. C.
valuable feature of this work. It is fully indexed, making it of considerable value as a work of reference. It is of pocket size, contains 223 pages. Bound in flexible leather, price $2.40; paper cover, price $2.00.

Personals

H. M. Roberts, until recently railroad representative of the General Lead Battery Company, has been appointed Sales Engineer of the Railroad Department of the Edison Storage Battery Company, Orange, N. J.

George B. Tripp is the new vice-president of the Pennsylvania Section of the National Electric Light Association. He was formerly vice-president and general manager of the Harrisburg Light and Power Company, and the first president of the Chamber of Commerce of that city.

Walter C. Rardin has been appointed Chicago representative of the Chelten Electric Company, manufacturers of electrical specialties, Philadelphia, Pa.

At a meeting of the Board of Directors of the Westinghouse Electric Export Company, in New York, held July 28th, new officers were elected with E. M. Herr as president.

H. S. Cooper, 405-406 Slaughter Bldg., Dallas, Tex., announces that he has made arrangements with the Southwestern Electrical and Gas Association whereby, while remaining its secretary and operating its office, he is free to do for himself such advisory and consulting work in the construction, operation and management of interurban and street railways, electric light and power plants, gas works and water-works as is outside the province and practice of the association.

San Francisco Awards "Home Electrical" Two Gold Medals

The "Home Electrical," an exhibit of the General Electric Company in the Palace of Manufactures at the Panama-Pacific International Exposition, has received the unique distinction of being awarded two gold medals by the International Jury of Awards.

This is but one of the exhibits of the company at the Exposition and consists of a full-sized, model home of simple, Spanish-California, bungalow design, in which electricity is made to perform practically all the domestic tasks and labors and to conduce to many of the households comforts of living. This home is completely furnished and attractively decorated, all in good taste, ready for occupancy. It comprises a large living room, dining room with breakfast alcove, bedroom, nursery, sewing room, bath, kitchen, refrigerator room and laundry. There are also an electric garage, a workshop and a small creamery. Electricity cooks, launders, sweeps, sews, and fulfills countless other domestic duties; and it also heats, lights and cools the house, all these electrical conveniences being suitable for the average family and within the means of a moderate income.

THE HOME ELECTRICAL AT THE EXPOSITION

One of the gold medals was awarded the "Home Electrical" by the Department of Manufactures for the completeness of the exhibit and as an exposition attraction. The sceond gold medal was awarded by the Department of Education in recognition of the high educational value of the exhibit. The "Home Electrical" has been thronged with visitors ever since the Exposition opened.

Electricity for Ship Propulsion

Results of recent tests have convinced naval engineering experts that the electric-drive system for ship propulsion has come to stay, and that its use is certainly justified in the new design battleships now under consideration.

Among the advantages derived from the electric system is the fact that the turbine always runs in the same direction, and at high speed, no backing turbine being necessary. There is no stopping and starting of the turbine in maneuvering. The turbine is small and easier to operate. Installations having two turbo generators can run all propellers with one set up to its maximum load. There is absolutely no racing under any conditions. Both motors, if running must run at the same speed.

One may be stopped and one running, or one may be backing and one going ahead, but always at the same speed. The engine-room watch is reduced. Full backing power always is available. It is very easy to operate. Signals can be answered quickly, making it reliable in an emergency. Finally, it results in a saving of coal. These advantages are not had with turbines directly connected to propeller shafts.

Review of the Month

A Complete Record of Important News Edited for Busy Readers

The Electrical Supply Jobbers Association held a meeting at Niagara Falls, Canada, September 14, 15, and 16. The chief paper was a comment on "The Selection of Jobbers as Viewed by the Manufacturer," by Robert Gloeckner, secretary and sales manager of the V. V. Fittings Co., Philadelphia. Electrical Prosperity Week was discussed, also various miscellaneous topics. Col. H. V. Carter, of the Pacific States Electric Company, San Francisco, described jobbing conditions on the Pacific Coast.

The third annual convention of the Southeastern section of the National Electric Light Association was held at Ashville, North Carolina, Sept. 22-24. A number of interesting papers were presented and the discussions on same proved instructive. Of chief importance was an address by Capt. W. T. Weaver, president of the North Carolina Electrical Power Company on "Hydro-Electric Development—its Present Potentialities and its Future Possibilities, as Applied to the Southland," and one on "Public Policy," by Governor Craig, of North Carolina.

The thirty-sixth convention of the Association of Edison Illuminating companies held at Spring Lake, N. J., devoted its chief attention to the matter of public service commission decisions. The report of the committee on standards and a general discussion of technical subjects was also a feature of the sessions. More than 400 delegates were in attendance.

A series of interesting papers on "Why Central Stations do not get all the Big Business," "Central Station Practice in Renting Motors for Factory and Mill Installations," "Standardizing of Voltages for Mill and Factory Motor Services," were the main features of the convention of the New England section of the N. E. L. A. held at Moosehead, Me., September 14, 15, 16 and 17. A paper on the "Developments in Mazda C Lamps and Their Effect on Central Station Business" and the report of the Electric Vehicle Committee on "Sales Development, Garaging and Charging, General Service, etc.," also claimed a good share of the convention's attention. Members of the commissions in the six New England States were in attendance and took part in the program.

At the last session of the Pennsylvania Electric Association convention, held at Bedford Springs, Pa., the following officers were elected: President, Stephen C. Pohe, Bloomsburg; vice-president, George B. Tripp, Harrisburg; secretary and treasurer, Henry N. Muller, Pittsburgh (re-elected); executive committee, E. H. Davis, Williamsport; E. B. Greene, Altoona, and F. M. Noecker, Renovo.

The Annual New York Electrical Exposition and Motor Show will be held at the Grand Central Palace, October 6-16. As formerly this will include an exhibition of all the new electrical apparatus and devices that have been placed on the markets during the past year.

The Electrical Age, your trade paper, will have a booth at the exposition and a visit to this booth will be worth while.

The Indiana Electric Light association held a three-day convention in Terre Haute, Ind. Talks by prominent electrical men from all over the country were given. T. F. Grover, superintendent of the Terre Haute branch of the Terre Haute, Indianapolis & Eastern Traction Co., is president of the association.

The convention of the Association of Iron and Steel Engineers was held at Detroit, September 8 to 11. The sessions were given over chiefly to problems of generating and applying electricity to the heavy-duty requirements of steel mill work. W. T. Snyder was elected president for the ensuing year.

At the annual convention of the Electrical Dealers and Contractors of Ontario, held at Toronto, addresses on "Rules and Regulations of the Hydro-Electric Power Commission of Ontaria," "The Resale Problem" and "Accident Prevention" proved of great interest. J. W. Comerford, of Toronto, was elected president for the year 1915-16.

The seventh annual meeting of the Indiana Electric Light Association was held at Terre Haute, September 8, 9 and 10. The program included a session of the various committees, addresses by the president, T. F. Glover, election of new members, officers, etc., and a reception for members and their ladies on the last night.

Electric cooking, overhead line construction and water power legislation were the principal subjects discussed at the convention of the Northwest Electric Light and Power Association held at Portland, Ore., September 8, 9 and 10.

The Missippi Electric Association section of the N. E. L. A. is planning a salutary remedy for the dryness which is so often part and parcel of the average convention. Long papers are to be omitted entirely and the sessions will be given over to the discussion of subjects of general interest. The convention will be held at Hattiesburg, Miss., November 12 and 13.

The American Association of Engineers held an informal "Boosters' Dinner" at the La Salle Hotel, Chicago, September 14. This was preliminary to the first national convention which the association will hold at the same place, December 10 and 11.

Robert Hayt and A. D. Moore, of Corning, N. Y., are purchasing land options with the intention of building an electric power plant on Mud Creek.

It is probable that a corn mill will be erected at Tuckerman, Ark., which will also install a plant for making electricity to supply Tuckerman.

The Wisconsin-Minnesota Light and Power Co. has announced the opening of an industrial department. This will be used for the promotion of the industrial growth of the communities reached by the power company. N. J. Whelan, former newspaper man and speaker of the Michigan House of Representatives, will be at its head.

Expansive business growth has caused the Western Electric Company to give up its old quarters at Portland, Oregon. Since 1910 the company has been located on Fifth street, but has now moved into a new two-story brick and concrete building which has been made ready for them at East Ash and Union streets. The building with well designed shipping, receiving and warehousing facilities is one of the most modern of its kind in the Northwest.

The American Steel & Wire Company has been awarded the Grand Prize by the Panama-Pacific International Exposition for the superiority of its products and the high character of its exhibit.

The Reading Transit Company, of Reading, Pa., is installing 258 new signal lights on all its lines. These are hand operated and can not be tampered with, each motorman carrying a key. The boxes are made in the company's shop in Reading.

It is known that Mayor Preston, of Baltimore, Md., has definitely decided against the plan to make use of the waste water power from Jones Falls at Lake Roland. It is estimated that such a project would save $45,000 to $50,000 a year in the city's electric light bill, but the $200,000, cost of the plant, is considered to be too large to be included in the budget for 1916.

A power plant has been placed in operation at Minetto, N. Y., which will furnish electricity for lighting and manufacturing purposes throughout central New York. The mill is owned by the Northern New York Power Corporation.

The long-distance power transmission line being built by the Consolidation Coal Company has been completed from Jenkins via Wayland and Allen, on Beaver creek, to Prestonburg, Floyd county, Ky. A number of the towns in the Big Sandy valley will receive power from the Jenkins plant.

The Coshocton Light and Heating Company, of Ohio, has been absorbed by the Ohio Service Company. Holders of preferred stock in the old company will receive an equal amount of the 6 per cent. cumulative preferred stock of Ohio Service Company which is a consolidation of the Coshocton and other utility properties in eastern Ohio. Holders of common stock in the Coshocton Company will receive 40 per cent. of their holdings in 6 per cent. preferred stock of the United Service Company holding company for the Ohio Service Company.

Current has been turned on for the new street lighting system installed in Clarkesville, Ga., by the Georgia Railway and Power Company. Work of completing the commercial and house lighting lines is being rapidly pushed to completion.

Reports from the electric generating and distributing company operating in Elyria and Lorain, Ohio, state that the new 5,000 kilowatt generator made necessary by additional business will be installed by Oct. 15. New business of the company includes 1,000 horsepower for the Cleveland Stone Co., also the Elyria plant of the Willys-Overland Co. is now taking 500 horsepower and will require double that amount in 1916.

The town of Chanute, Kansas, affords another example of municipal ownership failure. The town's finance committee has made a report covering the last three months of the fiscal year ended June 30, and it shows that the largest municipal enterprise, the gas works, produced a revenue of $18,882, while the cost of operating it totaled $21,992. This left a deficit of $3,110. The receipts of the municipal electric plant amounted to $3,884, but the cost of running it reached $4,272. Even the water works had a deficit of between $600 and $700, showing that Chanute made a record in bad management hard to beat.

The Norfolk & Western Ry., of Fink, Va., will equip its water supply station with electrical machinery for driving pumps; it has let the contract to the Southwestern Engineering Co., Bristol, Va., and will obtain electricity from the transmission system of the St. Paul Light & Power Co.

The Steelville Electric Light & Power Co., of Steelville, Mo., has been incorporated by John Zahorsky, Jr., A. H. Harrison and W. E. Evans. Capital $10,000.

The Warren Electric Co., of Branchville, S. C., has recently been incorporated for $10,000 by W. M. and R. M. Warren.

J. C. Waugh will rebuild the electric-light plant and ice factory recently burned at Blue Springs, Mo.

The Alabama Power Company, of Birmingham, Ala., has applied to Austinville for a light and power franchise to include street lighting. If the franchise is granted a secondary main will be extended from New Decatur to Austinville.

The Florida Ice & Power Co., of Lake Wales, Fla., has been incorporated with a capital of $100,000. E. C. Stuart is the president.

The Yancey Light and Power Company, of Burnsville, N. C., recently organized, will construct a hydro-electric plant to develop 100 h. p. and ultimately 200 h. p. Charles W. Harper is the engineer in charge.

The Price George Electric Light & Power Co. has recently been incorporated with a capital of $100,000; H. D. Eichelberger, pres., Chester, Va.; M. H. Mulligan, secy., Richmond, Va.; W. H. Hoyt, gen. mgr., Hopewell.

The Robbins & Myers Company recently won the Grand Prize for the best exhibit at the Panama California Exposition at San Diego. The company was also awarded a gold medal for electric fans and motors at the Panama-Pacific Exposition at San Francisco.

All mechanical power to be used in the construction of the $1,500,000 State Capitol at Oklahoma City will be electric and supplied by the Oklahoma Gas & Electric Company, which is one of the components of Standard Gas & Electric Co. The building will be constructed by James Stewart & Company, Inc., who have signed a contract for the power service. Several hundred horse-power in motors will be used and the service, while low in unit cost will amount to a considerable monthly sum.

The address of the Chicago office of the Westinghouse Lamp Co., has been changed from 39 South La Salle street to Conway Building, Clark and Washington streets.

The commissioners of the city of Brownwood have entered into a contract with the Texas Power & Light Company to install a complete electrically operated city waterworks pumping plant. Electricity for operating the plant will be furnished from the local power station of the company. Electric motors aggregating a total of 265 horsepower will be installed. New equipment will be used and the plant when completed will rank with the finest in the state.

The Lambertville Public Service Company has been recently incorporated in New Jersey for the purpose of manufacturing, generating, buying and selling electric current for light, heat and power. Capitalization is $50,000.

Arrangements have been made for the extension of wires from a central lighting plant at Flandreau, S. D., to Wentworth.

There is a project on foot to dam the Niagara river above Queenstown, Ont., and Lewiston, N. Y., to generate 2 000,000 horsepower of electric energy by utilization of the waters of the lower Niagara river. The cost is estimated at $100,000,000 and the work will be done by the New York State authorities in conjunction with those of the Province of Ontario, Canada.

Plans for the consolidation of the Heidelberg Township Electrical Lighting, Heating & Power Company of Heidelberg; Wernersville Heating, Lighting & Power Company, of Wernersville; Cumru Heating, Lighting & Power Company, of Cumru, and the Sinking Spring Heating, Lighting & Power Company, with the intention of reducing the cost of electric light, power and heat and establishing another electric company of larger proportions in Reading, Pa., are being actively considered. It is said that the McCall's Ferry Company, which operates one of the largest electric power plants in Pennsylvania is interested apparently with the view of establishing a foothold in Berks County.

The two electric companies at Wichita Falls, Texas, have consolidated.

It is probable that Cherry Valley, N. Y., will have electric lights. The local gas company is willing to sell its plant and franchise and arrangements will probably be made for a more modern form of lighting.

The Seymour Electric Light Company, of Seymour, Conn., has been awarded a contract to supply the Seymour Mfg. Company with 600 h. p. It is said that Seymour has the lowest power rates in the state.

Plans have been completed that will enable the Wrightsville Light and Water Company, of Wrightsville, Pa., to receive current from the Edison Electric Company, of York, Pa.

It is reported that the towns of Attica, Argonia, Milan and Mayfield, Kansas, are going to have electric lights. Contracts have been made with the Wellington light plant to furnish the electricity.

Moreland, Ga., is to be furnished electric current for light and power by the A. M. Camp & Sons Co., who will receive power for the Columbus Power Company.

At a recent election, Howard, Ia., voted to purchase and operate the local electric light system as a municipal plant.

It is reported that the majority of property owners in Lawrence, Kansas, are in favor of a "White Way" lighting system and that one will be erected very shortly.

Labor leaders in Schenectady, N. Y., claim that the labor unions there have been built up to an unprecedented strength during the past year.

The Mohawk Hydro-Electric Co., whose power house is located at Ephratah, eight miles north of Fort Plain, has been awarded the contract for the lighting of Fort Plain, N. Y.

There is some agitation on the part of the councilmen of West Chester, Pa. for the erection of a municipal electric lighting plant.

The New York Central R. R. has purchased a tract of land at Elmsford, N. Y., for the erection of an electrical power house and will begin at once the electrification of Putnam.

The Root River Power & Light Co., of Caledonia, Minn., has closed a contract with Mable and Spring Grove, for the extension of its lines to those places.

The Utah Power & Light Company has arranged for elaborate decorations for its building at the State fair this year. The pavillion will be given over to exhibits of electrical appliances, new styles of lighting fixtures, and demonstrations of cooking by electricity. The second feature will be the farm power exhibit showing the application of electricity on the farm for cutting and grinding feed, driving churns, washing machines, grind-stones and other apparatus The third department will be an exhibition of the application of electric power for pumping for irrigation.

The Niagara & Erie Power Company, a subsidiary of the Ontario Power Company, has applied for permission to construct lines and operate franchises in the towns of Sheridan, Pomfret, Portland, Brand and the village of Farnham, N. Y. It is probable that permission will be granted.

Elyria, O., is carefully considering the matter of a municipal lighting plant and is gathering figures of initial cost and cost of operation.

As a result of a vast increase in the demand for electricity the Huntington Light and Power Company, of Huntington, N. Y., has been practically doubling its plant at Halesite. A new 500 kilowatt Curtis turbine equipped with an auxiliary apparatus is being installed.

The village of Hanska, Minn., will be supplied with electric current by the Madelia Electric Co., a franchise having been granted them.

It is probable that Kalamazoo, Mich., will erect a municipal lighting plant. F. W. Ballard, city commissioner of light and heat, of Cleveland, Ohio, has been retained to draw the plans.

The municipal light plant at Hastings, Neb., has been enlarged by the addition of a turbine generator.

An electric light company has been formed under private auspices in Madisonville, Tenn., and will furnish the town with electric lights.

Through the efforts of the Merchants' Co-operative Association, the chief thoroughfare of Jersey City, N. J., is ablaze with white way illumination.

The five electric light plants of Urbana, Van Wert, Delphos, Deshler and Leipsic have been consolidated into an $800,000 corporation, known as the Northwestern Ohio Light Co. The purchase price of the the plant of the Urbana Light Co. was $243,500; the Leipsic light plant, $56,000; the Deshler light plant, $30,000; the Delphos Electric Light & Power Co., $151,-500, and the Van Wert Public Service Co., $308,500.

The Car Lighting and Power Company has bought the Crane plant of the Simplex Company in Bayonne, N. J., which will more than quadruple its capacity. The new plant is close to the works of the Electric Boat Company.

A lighting plant has been erected in Golden Valley, N. D. and a white way post lighting system is now being installed.

The Arkansas Light and Power Company are considering much improvement and development work in connection with the Camden & Paragould water plants recently purchased. The Paragould plant will probably be changed from a steam-driven to an electrically-driven system. Transmission wires will be extended to a half-dozen small towns in eastern and northeastern Arkansas.

BUSINESS OPPORTUNITIES

Mass., Boston.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until October 8, 1915, for the installation complete of an electric elevator plant in the United States appraisers' stores at Boston, Mass., in accordance with the drawings and specification, copies of which may be had at the Washington office.

Ont., Niagara Falls.—It is believed that the street arc lights now in use will be replaced by nitrogen incandescent lamps.

N. Y., Rockland.—The town board recently passed a resolution to illuminate the twin villages of Rockland and Roscoe with electric street lamps.

N. Y., Binghamton.—The city council has authorized the sale of $148,000 in bonds, the proceeds of which will be used for the construction of a municipal electric-light and power plant. D. W. Foster is City Clerk.

N. J., Trenton.—Commissioner Burke has presented plans for an approved lighting system in Trenton.

N. J., West New York.—It is probable that this town will install shortly a complete new system of street lighting.

N. J., Millville.—The City Commissioners have passed a resolution to ask for bids for the installation of a municipal electric-light plant. Plans for the proposed plant have been approved. N. B. Wade is City Engineer.

Pa., Tarentum.—Tarentum borough has authorized the expenditure of $21,000 for improvements to the municipal electric plant. Engineer Sidney B. Martin, of Pittsburgh, will have charge of the work.

Pa., Millton.—This town is seriously considering the erection of an electric-light plant.

Del., Milton.—The city is considering plans for an electric light system.

Md., Easton.—The Easton Milling Co. will install electric drive for 50 H. P., electricity to be purchased from the city.

Md., Baltimore.—The Consolidated Gas, Electric Light & Power Co. will erect additions to the depot on Monument St. near Front St.; 2 wings, 48x135 and 47x142 ft., respectively; 2 stories; brick, concrete and steel construction.

Richmond, Va.—F. P. Hudgins, 16 E. Marshall St., desires 100 ft. line shaftings and couplings, hangers, pulleys and 15 H. P. motor, D.C., 500 volts. Describe and state make.

Va., Richmond.—Under a resolution adopted by the Administrative Board recently on motion of Commissioner Hirschberg, it is proposed to operate the city locks by electricity instead of hand-power, the means utilized at present. The city Engineer was instructed to report on the proposition.

N. C.—Lumberton.—The city will improve the electric-light system; install about 6 mi. 2000-220-volt primaries and secondaries, series tungsten street light system, switchboard and transformers; Engineer, Gilbert C. White, Charlotte, N. C.

N. C., Lumberton.—Bids until Oct. 12 on electric-light system, including about 6 mi. 2200-volt primaries and secondaries, series tungsten street-light system, switchboard and transformers. Address the Mayor and Board of Commissioners.

N. C., Burnsville.—Prices on the following for water-power plant construction are desired: Cement; reinforced steel; 1-2-yd. concrete mixer with power; horizontal wate-wheel, 110 H. P. at 27-ft. head, with governor; 175 K. V. A. generator, 60-cycle, 2300 volts, 900 R. P. M., with exciter and switchboard; transformers, 2300 to 11,000 volts; transmission line fixtures, etc. Chas. W. Harper, Engr., Yancy Light & Power Co.

N. C., Charlotte.—The Park Mfg. Co. desires addresses of manufacturers of direct-connected turbine generators for plants using to about 500 or 1000 H. P.

N. C., Greensboro.—Specifications, description, prices, etc., on 75 K. W. direct current generator, 125 or 250 volts, direct connected to suitable engine, complete with switchboard, are desired by the Greensboro Supply Co.

N. C., Forney.—The Norwood Lumber Co. is in the market for a direct connected small dynamo and engine, new or second-hand.

S. C., Anderson.—J. F. McClure, Jr., 211 Webb street, is in the market for an electric motor.

S. C., Greer.—The city has recently voted $10,000 bonds for extending the street electric-lighting system. Address the Mayor.

Ga., Coolidge.—The city has engaged W. Hopson Goodloe, American National Bank Bldg., Macon, Ga., to prepare plans and specifications and supervise construction of improvements to the electric-light system.

Ga., Columbus.—The city will investigate cost of installing and operating an electric-light plant. Address The Mayor.

Ga., Columbus.—The Columbus Power Co. will, it is reported, double the capacity of its transformer station at Goat Rock water-power development; this increase is said to be necessary because of the increasing consumption of electricity at Newnan, Lagrange, West Point and other industrial cities in West Georgia.

Ga., Columbus.—The city is inquiring closely into the cost and operation of a municipal lighting plant and will probably establish one. A bond issue will be necessary to finance the plant.

Fla., Orlando.—Leonard D. Long desires samples of electrical fixtures for a $3,800 dwelling.

Fla., Gainesville.—The Municipal Water, Light & Power Co. contemplates purchasing 220 H. P. water-tube boiler; T. M. Early, P. O. Box 506, is Supt.

Fla., Mt. Dora.—F. L. Barrett, of Houghton, Mich., is reported to have petitioned the town council for franchise to acquire lighting rights of Eustis Water, Light & Power Co., which now supplies Mt. Dora; he also applied for water rights.

Fla., West Palm Beach.—The Southern Motion Picture Corp., Edgar W. Ruff, general manager, Box 614, desires price on a small electric plant.

Ky., Louisville.—H. P. Selman & Co., 4th and Walnut Sts. is reported as considering plans for a private lighting plant to be operated by oil engine.

Ky., Louisville.—Grainger & Co. desire an A.C. 3-phase electric motor, new or second-hand.

Ky., Clay.—The Perry Light & Ice Co. is constructing 3-mi high-tension transmission line and expects to purchase and in-

stall a belted second-hand 60-cycle 2200-volt single-phase 50 K. W. to 75 K. W. alternator, with exciter, type W. A. L. Fort Wayne being preferred; also second-hand 50 H. P. to 100 H. P. steam engine.

Ky., Cynthiana.—It is reported that the Kentucky Utilities Co., Lexington, is to buy Cynthiana Electric Light Co. and install new equipment throughout the plant.

Ky., Johnson City.—The city proposes to install an electric-light plant. Address The Mayor.

Ky., Providence.—The city will vote in November on issuing $20.000 bonds to build electric-light plant. Address The Mayor.

Miss., Koskiusko.—The city, W. G. Cambell, mayor has retained M. L. Culley, Jackson, Miss., to appraise the present water and light plants which may be purchased or make estimates for new plants. Bonds for $30,000 have previously been voted.

Miss., Prentiss.—It is reported that the Prentiss Electric Light & Mfg. Co. will install a 40 H. P. oil-burning engine.

Miss., Columbus.—The Tennessee & Mississippi Mfg. Co. is in the market for electrical equipment.

Miss., Prentiss.—The Electric Light & Mfg. Co. will install an oil-burning engine to replace steam power and develop 40 to 50 H. P.; W. C. Veach, Engr.

Tenn., Bristol.—Scouring Powder.—The Reynolds Corp. contemplates installing electrically-operated machinery in its factory (now using 150 H. P. steam and electric), and at mines (where water-power from 60 to 80 h. p. is used).

Tenn., Madisonville.—M. C. King, Copperhill, Tenn., and associates will organize a company to build an electric-light plant.

Ala., Atmore.—W. M. Carney Co. is reported as about to build 5 mi. transmission system.

La., Bogalusa.—Public Utilities Commission has accepted the report of G. U. Borde of New Orleans relative to constructing electric-light plant, water-works and sewer system; the citizens will meet ing October to consider a $200,000 bond issue.

La., Natchitoches.—Walter E. Aymond, Supt. municipal water-works and electric-light plant, contemplates building brick power-house and purchasing feeder panel for 100 K. W. generating unit; also the construction of a distribution system to East Natchitoches to require about 5000 ft. of wire and four 2 1-2 K. W. transformers.

Tex., Orange.—The Orange Light and Water Co. will rebuild the boiler house recently destroyed by a hurricane.

Tex., Brownsville.—The city contemplates extension of ornamental lighting system at a cost of $4500. Address The Mayor.

Tex., San Augustine.—The city council has appointed a committee to investigate and report on the cost of erecting an electric-light plant. Address The Mayor.

Ariz.—Peach Springs.—Plans for harnessing the power of the Colorado River in the Grand Canyon are under way. Six dams and reservoirs and hydro-electric plants are to be constructed. J. B. Girard, city engineer of Phoenix, is in charge of the project.

Ark., Little Rock.—The city will expend $25,000 for 210 street lights, 5 transformers, accompanying equipmnt, etc.; John W. Bleidt, City Electrician.

Okla., Grove.—The City, W. H. Davis, Clerk, will make extensions to the electric-light plant; no bids; construction under superintendent of light plant.

Okla., Jones.—The city has voted $10.000 bonds for electric-lighting and water system; Benham Engineering Co., Engr., Colcord Bldg., Oklahoma City.

Mo., Branson.—Ozark Power & Water Co. is perfecting plans for extending an electric-light system to various cities of west-central Missouri and possibly Kansas.

Mo., Drexel.—City will construct electric-light plant to cost $9,000; Bicknell Co., International Bldg., Kansas City, is in charge of the engineering.

Mo., West Plains.—The city is considering plans for improvement of the electric-light plant. Address The Mayor.

Mo., Bevier.—The city plans to vote on issuing $10,000 to $15,000 bonds to increase street-lighting facilities and for other street improvements. Address The Mayor.

Utah, Albion.—By a unanimous vote Albion citizens decided in favor of the issuance of $8,000 to be used in contracting for power for a lighting and power system.

Kas., Lawrence.—Plans are being prepared for a white way in this city. City Engineer Dunmire is in charge.

Neb., Laurel.—Laurel voted $12,000 bonds for a municipal electric light plant. The intention is to start the work as soon as the bonds are sold.

ELECTRICAL AGE

The National Monthly of Electric Practice

Formerly ELECTRICAL ENGINEERING

Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chas. B. Thompson, President **Wm. F. Eastman, Vice Pres.** **M. W. Ehrlich, Editor**

SOUTHERN OFFICE, GRANT BLDG., ATLANTA, GA. ***CHICAGO OFFICE, 651 MARQUETTE BLDG.***

Telephones: New York, Barclay 7448; Chicago, Central 3792

Volume 47 NOVEMBER, 1915 Number 11

CONTENTS

SUBSCRIPTION PRICE—United States and Possessions, Mexico and Cuba $1.00 a year. Canada $1.50 a year. Foreign Countries in Postal Union $2.00.

CAUTION—Do not pay solicitors, unless they present *written authority*, with date, from the publishers to collect money.

NOTICE TO ADVERTISERS—To insure insertion, all copy, cuts, etc., for changes of regular advertisements in ELECTRICAL AGE should reach us NOT LATER than the 15th OF THE MONTH preceding date of publication; three days earlier if proof is desired. The first advertising forms close promptly on this date.

NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 20th.

Member Society for Electrical Development *Member National Electric Light Association*

Recognized Organ of the Southern Trade. *Member Audit Bureau of Circulation.*

Entered at the New York Post Office as Second-class Mail Matter.

This Issue, 10,000 Copies

ELECTRICAL AGE

The National Monthly of Electric Practice

Formerly ELECTRICAL ENGINEERING

Technical Journal Company, Inc., New York

Vol. 47 **NOVEMBER, 1915** **No. 11**

The Latest in Current Consuming Devices

As Seen At The New York Electrical Exposition

This is the Volt Age—
This is when
The Volt gets in
Its work for men,
And from its source
Of mystery
Develops boundless
Energy.

This is the Volt Age—
In these days
A myriad new
And untried ways
Are opened up
Through which man leads
To betterment
Of human needs.

This is the Volt Age—
Now the slow
Activities
Of long ago
Give place to speed,
To skill to thought
From which ideals
May be wrought.

This is the Volt Age—
This is when
The pulse of progress
Throbs in men,
And like a beacon,
Clean and fine,
Irradiates
The spark divine.

—*W. J. Lampton.*

WHEN THE alacrity with which the various interests co-operated to make this year's Electrical Exposition of record value is realized; it is then self-evident that the extensive electrical and allied industries are experiencing a period of increasing prosperity.

One hundred and sixty-three exhibits were shown at this, the ninth annual Electrical Exposition, which was held at New York and lasted ten days. This event marks the end of another year of remarkable development in the electrical field which includes all that is new and practical in the use of electric curent. In the main, the snow is educational—in the sense that it aims to spread the gospel of "Do it Electrically" to the general public by demonstrating the various uses to which electricity may be put to for domestic, industrial and commercial purposes both for economy and comfort—showing that electricity is one of the important necessities of life. Aside from the general public interest, those in the electrical field were offered the opportunity of seeing that which is newest in electrical equipments; they also had the advantage of actual demonstrations of apparatus and appliances and in that way verify the descriptions given in manufacturers' catalogs and also gain first-hand information on the behavior and operation of such equipments.

The Show was opened on the afternoon of October 6, by Charles C. Moore, president of the Panama-Pacific International Exposition speaking over the trans-continental telephone at the San Francisco end to invited guests at the Grand Central Palace in New York. Each guest was provided with an individual telephone receiver set connected to the same circuit.

Pres. Charles C. Moore said in part: "It is a pleasure to me to be able to say a word of greeting at the opening of the Electrical Exposition and Motor Show of 1915. I feel, in a way, as though I were speaking from one electrical exposition to another, for much of what is best in the Panama-Pacific World's Fair is due to the manifold applications of current. When our general exposition was first planned we intended to have an electrical building, but, as we came to consider the matter more carefully we saw that no one building could possibly contain the countless uses to which electricity is put to-day in home, shop, street and factory. And so we found that our whole exposition was a vivid, living example of what electricity means in modern life.

"In somewhat the same way, but with more concentrated emphasis, the New York electric show presents the wonders which current stands ready to perform for the community. It is fitting that such a display should be brought together each year in what is doubtless the world's greatest electrical city—for I understand that in New York the various central stations and street railways are generating an aggregate annual output of

nearly two billion kilowatt hours, or the equivalent of about 324 kilowatt hours per capita per year. So large is this total that I doubt whether even Edison himself, 33 years ago, would have prophesied so tremendous a future for the industry he was then founding.

"I cannot close without a word of congratulation to all of us on being able to converse across a continent, for this is perhaps the greatest wonder that has yet been wrought by electric current."

Then followed the response over the trans-continental telephone from the New York end. Arthur Williams, president of the Electrical Exposition, speaking. This address, though brief, is a concise description of the show and follows in part: "On behalf of our audience here it is scarcely necessary for me to assure you, Mr. Moore, that we consider it a privilege to begin the 1915 Electrical Exposition and Motor Show with this trans-continental greeting. If any one had told us last fall that we would be able to do so now, I am afraid we should not have believed it. And yet we of the electrical industry ought to know only too well that progress in our day wears seven-league boots.

"I think we are especially fortunate in feeling that through you we are communicating with the Panama-Pacific Exposition. Many of us who are here this afternoon visited San Francisco last spring when the National Electric Light Association met near the Golden Gate. We have not forgotten the cordial welcome we received and we remember with unusual pleasure your own kindness in coming to address one of our sessions.

"We wish that to-day we might reciprocate and ask you to join us in a tour of our Exposition. You would not find it so large as your own, but in the single department of electricity I believe it is as complete a display as has ever been assembled in this country. Not only are divers industries represented, but we also have our government and municipal exhibits. Among these latter are contributions from the United States Army, the Navy, the Treasury Department and the New York Board of Education. By permission of Secretary of War Garrison, the Springfield Arsenal is demonstrating the manufacture of army rifles and sabres, and we are perhaps excusably proud of this exhibit because it is something that even the great Panama-Pacific Exposition has not shown.

"Last year over 150,000 people visited our Electrical Show, this being the largest attendance at any indoor exposition ever held in New York City. Remembering that the figure was reached in spite of the depression which followed the outbreak of the war, we are hoping to surpass our own record this fall."

Another part of the formal opening ceremonies included the starting of an electric car on its cross-country trip to Cleveland where the Electric Vehicle Association of America was then holding its convention. This trip was undertaken for the purpose of demonstrating the possibilities of the modern electric vehicle and to secure accurate data on the cost of operating such cars over country roads; one of the Ward Specials being used for this test. The drivers of the machine were accompanied by an independent observer whose duty was to keep an accurate record of such items as mileage, charging of batteries and boosting. In the photograph may be seen Arthur Williams handing a message to the driver of the "electric," to be delivered to the engineers convened at Cleveland.

After the formal opening of the Exposition, the booth housing the trans-continental telephone was given up to public exhibition. In order to give the visitors an opportunity to become acquainted with this system of telephone transmission, hourly demonstrations were given by the American Telephone and Telegraph Company its associated companies representing the Bell System, in the auditorium which was equipped with 164 seats, each provided with two telephone receivers, as shown in the illustration. The program at each demonstration included a talking moving picture portraying the birth of the telephone; pictures showing the construction of the trans-continental telephone line from New York to San Francisco and the actual connections that have to be made

Arthur Williams Starting the Ward-Special

in order to talk over the telephone between the two cities. After connection with San Francisco, the audience is actually permitted to individually use the receivers. Then one of the company's representatives at that end transmits the western news of the day which is followed by a musical selection sent over the wires. After the musical, the roar of the Pacific Ocean is heard, this being transmitted over the telephone through an instrument located at Seal Rocks near San Francisco. In order to make this latter more realistic, a moving picture of the Pacific shore with breaking waves accompanies it. With an actual demonstration in this manner, taking only 15 seconds to connect across the continent, the listener is made to realize that the trans-continental telephone is one of the most important of recent electrical achievements.

The central station interests did their share to make the Exposition an educational success by providing suitable exhibits touching on the various phases of the in-

dustry. Courteous attendants in charge politely answered all questions and when necessary gave an actual demonstration of the use of any appliance that the individual visitor may have been interested in.

The Edison Illuminating Company, of Brooklyn, featured the fact that almost every large concern in their territory is supplied with electric service from their mains. To illustrate this point, a panoramic view in colors showing the waterfront of Brooklyn was exhibited; this was about one hundred feet long and is reproduced in one of the photographs herewith.

The New York and Queens Electric Light and Power Company features the fact that their territory is one unexcelled as regards shipping and transportation service and combined with their electrical service, the borough of Queens offers to manufacturers all the advantages of convenience and economy. Maps, charts and photographs emphasize this point and a display of electrical appliances for the home completes their exhibit; this may be seen in the photograph of their booth.

Auditorium Housing the Receivers of the Trans-Continental Telephone at the Show.

The New York Edison Company, realizing that in order to serve a city like New York, the central station must consist of more than a power plant and a distributing system, has established various special bureaus through which their customers may receive information on the particular subject that may be under consideration. The Edison Company was therefore representel by several exhibits of its various departments which were placed in different parts of the Exposition. One booth was for the reception of visitors from the Bronx borough where information as to electric service in that territory was given. Another exhibit had on view different types of lighting units and was in charge of illuminating engineers who would give data regarding any particular form of lighting installation. Some of the other exhibits included the Sign Bureau, Educational Bureau, Advertising Bureau and Photographic Studio. Several of the photographs herewith reproduced were taken by this studio.

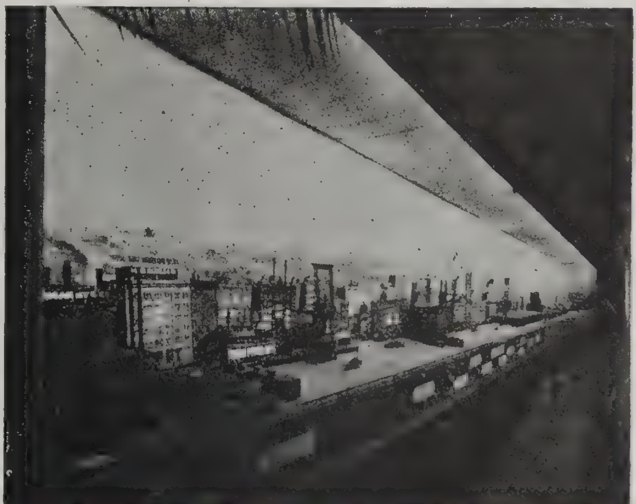
The space which the United Electric Light and Power Company had occupied was divided into three sections. One was used as a reception room and office and the other was occupied by the Electric Shop which was fully equipped for the demonstration of domestic electrical appliances. Between these two booths was exhibited a panoramic view of the Hudson River and the waterfront of upper Manhattan.

Among the manufacturers many forms of motive apparatus, wiring and lighting specialties, and domestic heating and labor-saving devices were exhibited. Lack of space forbids enumerating every exhibit.

The General Electric Company of Schenectady, N. Y., departed from the general scheme of displaying equipment but was still in harmony with the aims of the Exposition by showing moving pictures of an exceedingly educational value. These were shown not in a dark room as is customary, but under the conditions of broad daylight. These showed the methods and steps in the manufacture of various types of apparatus, occasionally a comedy was thrown on the screen in order to avoid any possible monotony.

The Junior Electric Range in Use

The Westinghouse Electric and Manufacturing Company, of East Pittsburgh, Pa., exhibited a complete line of electrical devices for the home, shop, office, etc. The particular feature of this display was a new electric range which has proven exceedingly popular because of its manifold advantages. This range has an automatic feature which allows the housekeeper to put a meal in at any time, set it for the hour at which the dinner is desired, and then leave the rest to the range. At the appointed hour the dinner will be found already cooked.



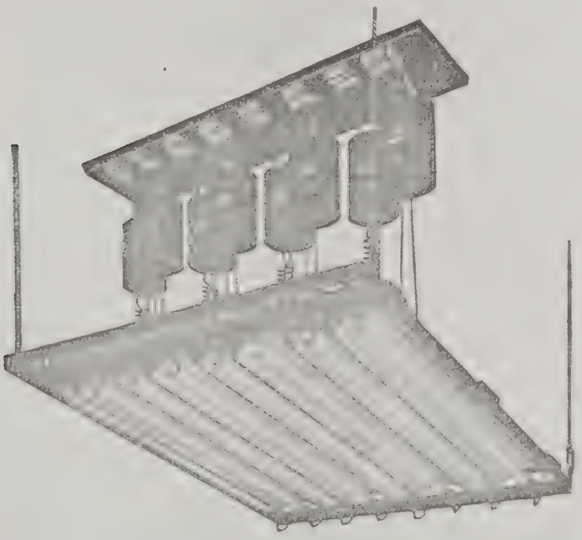
Panoramic View of the Brooklyn Water-Front

In addition to the range, there is a complete line of heating appliances, new type grating fan, meters, trans-

formers, rectifiers, circuit-breakers, motor-generator sets, Ventura fans, etc.

The company also has on exhibit a rack of various sizes of tungsten incandescent lamps, showing both the vacuum type and the gas filled lamp. The durability of these lamps was demonstrated by a device that gave a lamp a sharp blow about once a minute. The illustration herewith gives a general view of the booth.

The Western Electric Company, of New York, made a general showing of their extensive line of electrical devices, among them being the Hughes range, designed for domestic and commercial purposes; motors for attachment to sewing machines; various sizes of vacuum cleaners; electric washers and interphones. A unique feature of this exhibit was the actual demonstration of a Junior range, illustrated herewith. This device, which a prominent central station man has characterized as "the greatest electrical novelty in years," is a practical, miniature electrical range, complete in every detail, upon which real food can be boiled, baked or fried. It is intended for the use of young girls as a toy and also as a means whereby they may be taught to cook.



Cooper Hewitt Skylight Unit

The Cooper Hewitt Electric Company, of Hoboken, N. J., featured their lighting equipment for commercial and photographic purposes. The skylight outfit shown herewith is designed for direct current circuits and may hold from 4 to 8 tubes, depending on the lighting requirements.

Revolving Brush Vacuum Cleaner

The tubes are of the automatic lighting type and do not have to be tilted for starting, of 50-inch size, mounted in angle iron frame which holds the reflectors. This skylight frame may be hung so that any elevation and any angle of light can be obtained from horizontal to vertical.

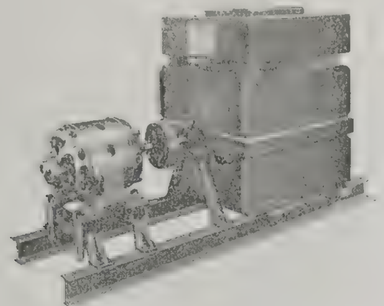
The Hoover Suction Sweeper Co., New Berlin, Ohio, were showing a complete variety of their different sizes of electric suction sweepers. Practical demonstrations were given, to show the merits of their motor driven revolving brush which sweeps up the adhered lint, threads, sewing room litter, etc. It is claimed that only by vibrating or shaking the floor coverings, can the ingrained dirt be loosened and that this is done thoroughly through the action of their electrically revolved brush, which jars loose and brings to the surface the embedded dirt that has been ground into the carpet, and the suction produced by their powerful fan mechanism, draws away all the dirt that the brush loosens. This sweeper is sold only through the retail dealers of the trade.

The Electric Fountain Company, 348 West 42nd St., New York, showed several designs of self-contained electric fountains, one pattern being reproduced herein. This company is the only one who manufactures a type of portable electric fountains which requires no outside water piping or other plumbing connections. A gallon or two of water put into the basin will last for several weeks, it being forced through the fountain by an electric pump, and the same water is thus sprayed over and over again. This feature makes the fountain portable and in its various artistic forms it can be made part of any scheme of interior decoration. Such devices find ready sale for installation in theatres, restaurants and even private homes. The small sizes of electric fountains are especially suitable for home purposes, taking the place of the usual fern dish for table decoration.

Portable Electric Fountain

The Kinetic Engineering Company, Philadelphia, Pa., manufacturers of organ blowers and blowers for special purposes, demonstrated some of the applications of air to the production of music, the feature of the exhibit being the Kinetic organ-blower in operation. This motor-driven blower, as illustrated, is of the centrifugal fan type, and is suited to withstand the varied atmospheric conditions of different localities; it is as noiseless in operation as it is possible to make a moving fan. The blower consists of various fans mounted on one shaft, each fan taking the air in turn and adding the pressure generated by itself to that of the next, raising step by step the pressure required by the instrument blown. Motor-driven blowers for reed organs as well as player-

pianos, to do away with the labor incidental to the operation of the foot bellows, were also shown. A combination pressure and vacuum electric blower operated what is commonly termed a moving-picture-orchestra. The organ element requires air pressure, while the other elements such as piano, snare drums and bass drums operate on vacuum, and the Kinetic blower in one unit takes the place of several units, thereby making simple what was formerly a complicated and troublesome system.



Motor-Driven Organ Blower

The Hamilton-Beach Mfg. Co., of Racine, Wisconsin, featured their new "Sew-E-Z" Sewing Machine Motor, which is attracting much favorable attention among appliance users. The motor, of 1/18 hp., differs from the usual type of sewing machine motor in that it requires no bolts, screws or mechanical fixings to attach it to the sewing machine, and can be adjusted or taken off in a few seconds. The motor rests firmly on the top of the machine. The shaft is extended and equipped with a frichine. The shaft is extended and equipped with a friction pulley which engages the flywheel of the machine and presses against same by means of a tension spring in the base of the motor. A specially constructed rheostat mounted on a foot pedal provides six different steps of speed, it being possible to make a single stitch or several hundred stiches at a time. The company was represented by its branch manager, J. Jorgenson, of 114 Liberty St., New York.

The Simplex Electric Heating Co., Cambridge, Mass., through their agent, Roger Williams, of 120 West 32nd St., New York, exhibited a number of interesting devices. Among the new appliances shown were a Quickhot immersion heater which will boil a cup of water in

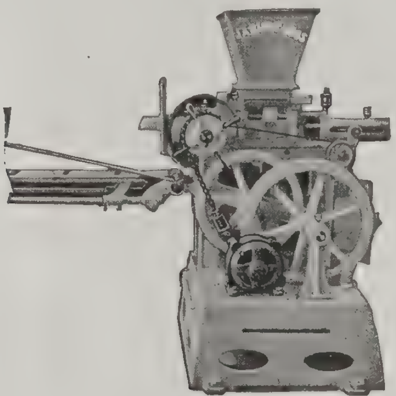
Adjustable Sewing Machine Motor

three minutes and a percolator that holds three pints and arranged to prevent it from burning out even if the user does allow all the water in the pot to be evaporated. A detachable connector is put on this pot so that it can be quickly put on and removed with one hand, a feature that everybody will appreciate. The new toaster shown has an exclusive feature in the form of a toast rack to hold six slices of toast. In conjunction with

General View of the Electrical Exposition together with several booths showing the exhibits of the Central Station, Manufacturers, Engineers and displays of appliances for home comforts.

the electric bakery described below, two large Simplex ovens were used of a type as illustrated.

The Electric Bake-shop was operated through the co-operation of the Fleischmann Bakery, Jaburg Brothers,



Electric Dough Divider

of 12 Leonard St., New York, and the Simplex Electric Heating Company. Bread and cakes were made openly on the premises, and while the greater part was on sale, visitors received sample loaves. The most notable feature was the lack of dirt—the sanitary condition being the result of a complete electrical and mechanical equipment. Among the motor-driven machinery used, may be named the Jaburg automatic dough-divider which is herewith illustrated. This machine divides the dough with absolute accuracy into pieces of any desired weight and it does this not only in a much more rapid and cleanly manner than can be done by hand, but also does the work in an easy manner so that the "life" of the dough is retained.

Electric Bake-Oven

The Modern Home Washer, driven by a ⅛-hp. electric motor was exhibited by the Home Device Corporation, of Bush Terminal, Brooklyn, N. Y. This has the advantage of fitting and operating in the stationary tubs already in the home, thereby saving the space taken up by a washing machine of the portable type, as shown in the illustration. The capacity of the machine is eight full size bed sheets or eighteen shirts. As there are no bearings outside of the tub, the machine may be filled over two-thirds full. One lever operates the washer, and one operates the wringer, which is reversible. The cylinder reverses automatically. No springs or ratchets are used in the mechanism, which runs in grease, and is filled but once in two years.

The exhibit of the H. W. Johns-Manville Co., of New York, brought out the importance of correct lighting—and the fact that the great majority of offices, shops

Electric Washer for Stationary Tubs

and homes to-day are incorrectly lighted—in many cases at probably greater expense than for the right way. This company is now the exclusive sales agent for the Mitchel Vance lighting fixtures and bronzes; Gill Brothers translucent ware used in semi-indirect lighting, and the I. P. Frink systems of diffused reflective illumination. A selection of the latest designs and newest achievements of each of these three organizations was shown at the booth. The Mitchell Vance designs to be slowly introduced were given their first public exhibition.

Landers, Frary and Clark, of New Britain, Conn., had a display of "universal home needs electric," showing an extensive line of appliances made up in nickel-plate and copper but also featuring a new departure in the making of appliances in American Sheffield-plate with the old Sheffield etching, and at very reasonable prices.

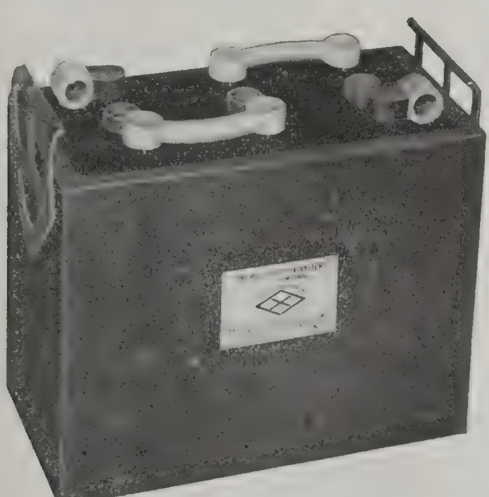
The Van Brizzle Tile and Pottery Works, of Colorado Springs, Col., exhibited what may be considered quite an advance in ornamental table illumination and general lighting effects that may be gained by portable lamps. As shown in the illustration these consist of very fine pottery in varied designs of animals, table vases, urns, etc., within which is concealed an electric lamp which throws its illumination out through the aperture in the figure. For instance in the owl figure the lamp throws its light

out through the owl's breast and eyes. This pottery is made in any color desired and finely glazed; the manufacturers will duplicate any shade of color to match other decorations desired. As a Christmas novelty this lamp particularly is worth the dealers' consideration. H. C. Biglin and L. E. Moffatt, the manufacturers' representatives in the East, having established offices in the Fuller Building, New York.

Pottery Table Lamps

The Electrical Refrigerating Company, Inc., Woolworth Building, N. Y., exhibited the Williams automatic electric refrigerating and ice making machine as herein illustrated. This machine, intended to supersede the old time refrigerator, is designed to provide all the artificial chilling and all the ice necessary for table use by the average family. As a household refrigeration, it is marked with the features of safety, simplicity in operation and continuity of service. The electric refrigerator is a motor-driven ice machine adopted to any standard refrigerator. The freezing end proper, occupying what would ordinarily be the ice box, the complete equipment forming a compact unit as may be seen in the illustration. Artificial refrigeration by this electric machine may be had at practically half the cost of purchased ice under New York conditions.

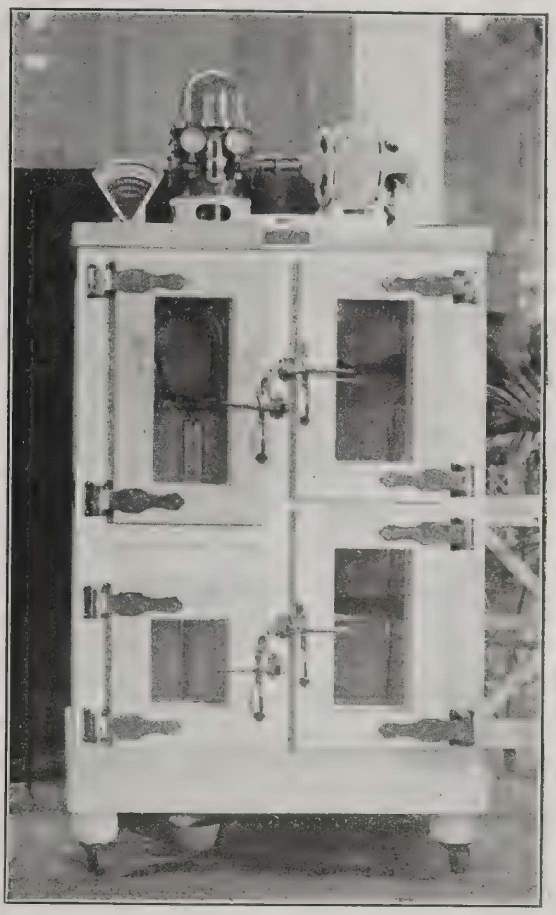
The Philadelphia Storage Battery Company, of Philadelphia, Pa., exhibited electric vehicle batteries for pleasure and commercial electric car service together



Electric Vehicle Battery

with a complete line of starting and lighting batteries for gas cars. The electric vehicle exhibit featured the new type of diamond grid thin plate, known as the W. T. X. I. This has a 10 per cent. greater capacity and life than its predecessor, the W. T. X., and is considerably lighter in weight. Compared to thick plate batteries it has 50 per cent. more capacity, 25 per cent. more life, and 33 1/3 per cent. less weight. The W. T. X. I. has already been adopted by the leading pleasure and commercial car manufacturers and thus about 80 per cent. of all 1916 electric pleasure cars will contain these batteries as standard.

The Morgan Crucible Company, Ltd., 114 Liberty St., New York, exhibited their line of copper-graphite, carbon and pure-graphite brushes for use on various classes of electrical machinery. In order to demonstrate the care which is used in selecting brushes they have on exhibition one of their brush-testing machines, this being

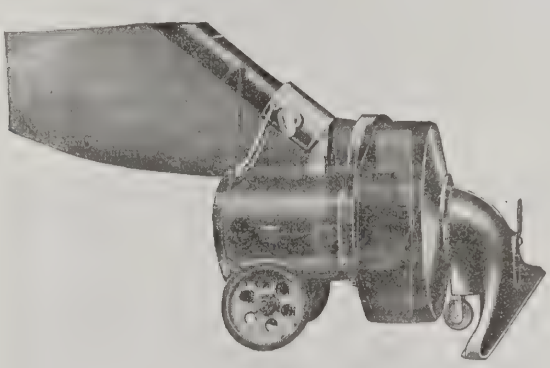


Electric Household Refrigerator

in the form of a Diehl Dynamometer. With this dynamometer very accurate brush tests are made, such as the co-efficient of friction of brushes, the contact drop of brushes and also the complete brush loss can be computed. The readings obtained from this machine are accurate to $\frac{1}{2}$ of 1 per cent.

The Innovation Electric Company, 587 Hudson St., New York, exhibited their Magic and Liberty vacuum cleaners. The first type as herein illustrated has established a record for durability and efficiency. The model has been changed from time to time, and the one shown embodies a number of improvements. The chief claim made for this cleaner is that it has a special Westinghouse motor with compensated winding; as a result, the commutator deterioration, common with high-speed motors is eliminated. The Liberty is a popular priced cleaner, retailing at $25.00. It is equipped with a special

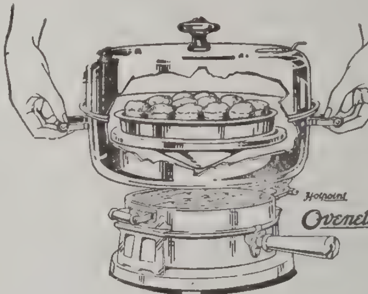
General Electric motor and self-feeding wick oil cups. This cleaner has a number of exclusive features including a reversible nozzle brush for removing surface litter, threads, etc. This brush when not in use may be turned over in the nozzle out of the way, allowing the nozzle to be sealed by the carpet, removing all deep-seated dirt. The cleaner is practical in design and easy to operate.



The Magic Vacuum Cleaner

The Lux Manufacturing Company, of Hoboken, N. J., featured their new 40 and 60 watt nitrogen incandescent lamps. These small sizes of gas-filled lamps are the first of their kind to be manufactured in this country. The list price of the 40 watt nitrogen is 75 cents and the 60 watt lists at 90 cents.

The Hotpoint Electric Heating Company, of New York, featured a new device designed to operate in conjunction with either their El-Glostovo or El-Grilstovo, both of which are 7-in. open coil stoves. This appliance, illustrated herewith is known as the Ovenette. When placed on top of either of the two stoves named, it will enable one to roast meat, bake biscuits, pies, etc., the parts being arranged to suit the work to be done.



Combination Oven

The bottom part is so arranged that the heat rising from the stove does not come up through the pan, but is spread at the center and directed up along the sides to the top. In this way an even distribution of heat is obtained. The top cover is equipped with a vent to allow for the escape of steam.

In keeping with the policy of the publisher, this, your trade paper, ELECTRICAL AGE, the National Journal of Electrical Practice, was also represented with a booth at the Exposition. This booth was used for reception purposes and the latest books on the electrical field were available for perusal. Several hundred visitors registered by taking a one-year subscription of this journal.

USE OF PORTABLE COMMUTATOR SLOTTER

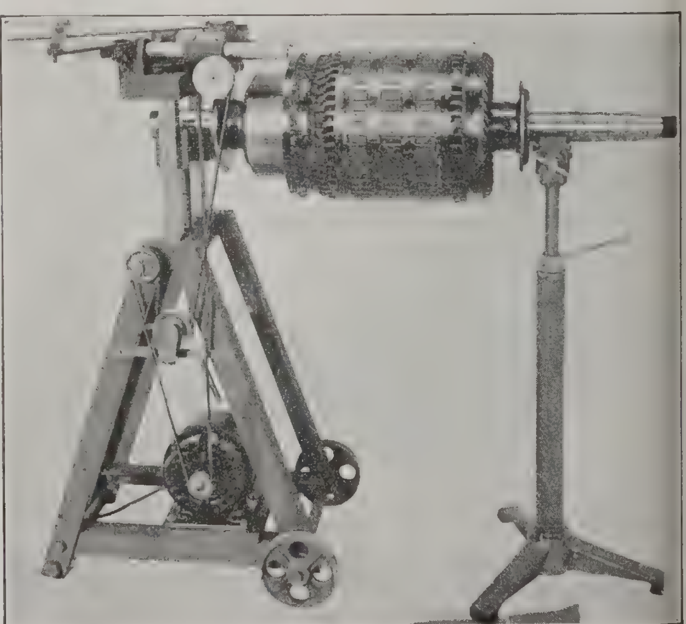
THE accompanying illustration shows a portable electric machine which is capable of the highest class of rapid and accurate work in slotting of commutators. It is adjustable for armatures of various lengths and any diameter; has a corrossive adjustment to bring the travel of the saw always in line with the mica slots and cuts by sawing to any desired depth. An electric motor at the base supplies the necessary power. The machine may be adjusted for handling the smallest air compressor commutator to those of 18 inches in diameter and of any practical length.

These portable commutator slotters may be easily handled and transported from place to place by grasping the projecting shafts and tilting it somewhat on the order of a wheelbarrow, so that it is frequently more advantageous to take the machine to the armature than the reverse.

It will be seen that the commutator end of the armature shaft is supported in a V-bearing, which is adjustable in height to suit the diameter of the commutator, so as to bring the cutting saw to the proper depth. The saw is clamped by a nut to the spindle which runs in a long bearing bolted to the sliding head. The bearing is removable and is cheaply replaced when worn. The sliding head is carried by two shafts projecting over the commutator and is traversed over the slots by the lever, which is placed at a convenient height for the average operator to accomplish the quickest and best results. The pivot positions of the operating lever can be changed and adjusted to suit the size of the commutator.

It will be noted that the other end of the armature shaft is supported on the special stand as illustrated. This can be raised or lowered according to the diameter of the commutator and to bring it level with the cutter. In this rear support, provision is made to adjust the armature crosswise in order to bring the travel of the saw always in line with the mica slots. This is an extremely valuable feature for the reason that the mica frequently does not run true with the shaft, and this adjustment is therefore of great importance.

This portable commutator slotter requires a 1/8-h.p. motor for this operation, although if used as a stationary tool the independent motor may be dispensed with if desired and the saw spindle pulley belted direct to a counter or line shaft. The weight of the machine proper without the motor is 148 pounds and of the rear support 35 pounds.—*F. C. Perkins.*



Motor-Driven Portable Commutator Slotter, suitable for armatures of various lengths and diameters.

EDITORIAL

Concentric Wiring Systems

IT IS gratifying to learn that the system of grounded concentric conductors for small interior-wiring installations is now being earnestly discussed throughout the country and it is hoped that this system will within a short period assume a commercial status.

The number of people that are learning to appreciate the benefits of electricity are constantly increasing, but electric service seems to remain beyond their reach, not because of the rates charged for the supply, but simply on account of the first cost of wiring equipments as they are installed to-day. Most central stations realize that it is profitable to handle the small consumer including the residence load and that of the small merchant; as a matter of fact the greater part of many electric services throughout the country are made up of this composite load. But how to extend business of this nature is the pertinent question that must be answered, and the solution seems to lie in a system of wiring that may be easily installed at a low cost and at the same time be sightly and safe—and that is just what the bare concentric system of grounded wiring represents.

This system of interior-wiring is by no means intended to displace any methods now in vogue as it is being considered solely for branch lighting circuits in small systems. The concentric wiring method is a European system and it was the same conditions that now confront the American interests that brought about its extensive use across the ocean. With the introduction of the new high-efficiency tungsten lamps, the current consumption for any given lighting equipment is reduced and the cost of lighting by electricity is therefore similarly lowered, and to combat this condition the central station must increase its total number of consumers. In the European countries this was accomplished by the introduction of a relatively low-priced wiring system mainly in the form of concentric conductors. It was then found that electric service was recognized even in the most humble home, so that a cheap installation combined with low current consumption resulted not only in satisfaction to the customers but increased revenue to the electric service company and the allied trades.

Electric systems for varying services, are almost universally controlled to a certain degree by local rules and restrictions, and it is only with the co-operation of the authorities having jurisdiction, that the introduction of a new system can be made a reality. On account of the lack of detailed specifications and a thorough knowledge of the concentric wiring system, the alarm of about a year ago was perhaps justified but since then through the combined efforts of engineering organizations, fire insurance and municipal authorities, the central station and the manufacturer, several test installations have been made in Boston, Chicago, Louisville and other cities.

When the details of these experimental wiring equipments become available, it will no doubt be found that the concentric system, using proper fittings, is easy to install and has the advantage of low first-cost; then the apparent hazards attached to this system will immediately disappear. It is significant to learn that the fittings used in these trial wiring installations are mostly of American make.

It is now time, therefore, for the manufacturers of fittings and lighting accessories to consider the opportunity offered, and hold themselves in readiness to adjust their plants for the new accessories. It should be borne in mind that the concentric or any similar surface wiring systems will in no way interfere with present forms of electrical construction but it certainly will mean an increase in business for the manufacturer.

The writer hazards to say that developments along this line, within a period of two years, will emphasize the fact that the grounded concentric system of interior-wiring is here to stay. Such adoption would merely be a happy outcome for the central station, electrical workers, manufacturers, and the small consumer, as it would mean the wiring of many existing buildings which means the additional use of accessories, the supply of current and the comforts of electricity in more homes.

Station Conditions

WITH THE tearing off of the October sheet from the office calendar another winter is upon us. Soon the lighting load will have climbed to its peak, boilers and generators will be going at high capacity, snow and wind will be playing tricks with the overhead lines, and the trouble bells will begin to ring.

There is no one to whom the old saws about the ounce of prevention and the stitch in time are more applicable than to the man who generates and distributes electrical energy; and no one better realizes their truth. Now is the time to get ready to meet the winter conditions. If any boilers need overhauling do it now; in a month you won't be able to cut them out of service. If the line needs strengthening get the gang out now; don't wait to clear a tangle of poles and wires from the roadway with the mercury playing tag at the bottom of the tube. Remember the guys that last year you wished you could have and see that they are in place this winter. Be prepared, it pays.

Economic Unrest

AGAIN the effects of the war have been felt here—this time among the electrical and mechanical industries, causing an economic unrest among the laboring class and resulting in a serious condition between the employer and employee. Perhaps the main crisis is now over, but labor strikes on a small scale will

no doubt continue. This status of affairs is mainly due to the abnormal conditions created by the influx of money to this country for war orders which are to some extent being filled by the various plants of the mechanical and electrical interests. Financial circles are probably more to blame than any other set of people for such conditions on account of the excited rumors created by them; these have resulted in artificial values which have upset the market and set prices soaring thus keeping the buying and selling at its height. This has naturally created a popular conviction that manufacturers, the employers of labor, are making extraordinarily large profits.

If economic conditions of this nature were not artificial, then labor would be justified in its demands for a share of the added profits, and even though there may be an extreme instance where such profits are a reality it should not be forgotten that at best it is only temporary. But labor, it will be seen, is not really to blame, as it has been led to believe that such conditions actually exist and on that basis, therefore, an increase in wages is rightfully demanded. In many instances the wage scale has been increased, but the fact that such action is dangerous, unless the condition under which the increase is given, is made clear, should not be lost track of.

The points raised in this connection have been recently very clearly stated by President Westinghouse, of the Westinghouse Air Brake Company. Referring to war orders and profits, he said in part: "While the times are favorable, with ample guarantees against contingencies, these orders have necessitated a heavy expenditure for special machinery and for its installation in temporary though substantial buildings, to the end that the maximum output of the company's regular product might not be affected in case of a sudden revival of the railway supply business.

"It is expected that when the value of this special machinery and the buildings not available for future use shall have been charged off, the net result will represent a substantial but not unusual manufacturing profit on the amount involved."

Electrical Prosperity

THE SELLING campaign conducted in connection with the 36th anniversary marking the invention of the incandescent lamp has just been successfully carried in the form of an Edison Day, celebrated on October 21 throughout the entire country. This vast undertaking has proved to be of considerable educational value and with the Electrical Exposition recently held in New York, as described by the leading article in this issue of Electrical Age, both have paved the way for the success of the much heralded Electrical Prosperity Week. For this land-wide campaign, designed to increase the business of the vast electrical industry and the allied trades, the week of November 29 to December 4 has been particularly chosen so that it might come directly before the Christmas season. In the local and national advertising featuring this week the "Do it electrically" idea has been well instilled in the minds of both young and old; the shop-early idea has also been well spread so that the minds of the holiday purchasers may be directed toward the enormous numbers of useful electrical devices that are available to help solve the problem of gift-giving.

In previous issues of Electrical Age, plans have been proposed and the details of the campaign announced so that you may profit by Electrical Prosperity Week. If these have for any reason been missed, the Society for Electrical Development of New York, the organization which is actively directing this movement throughout the length and breadth of the land, will no doubt be pleased to send you specific details as to what you can do to benefit by the campaign. Reports from various sources point out that this movement is being actively supported everywhere, and it is therefore expected that the *Week* will be a greater success than was ever anticipated.

American Machinery in China

We would call attention to a resolution passed by the American Association of North China urging American manufacturers to place American machinery in Chinese technical schools and universities. The British have been doing this for some time, notably in the University in Hongkong, where British engineers have united for the purpose of supplying the University with complete sets of machineries and implements so that a student in the University can acquire as thorough a knowledge of engineering as if he were trained in England. These students being familiar from the beginning with machinery of British manufacture, machines of British make will naturally find favor with them in their future careers. This matter is of supreme importance to American manufacturers and we will be glad to suggest the kinds of machinery in demand and the institutions where they can be well placed.—*The East and West Review.*

Current Conversion.—Alternating current has one peculiarity which direct current has not. Its voltage, or pressure, can be easily raised or lowered, making it most economical for long distance transmission. But there are many uses for electricity where alternating current will not do at all, namely, battery charging, electroplating, street railway and locomotive service, and many others. For these purposes the alternating current has to be changed into direct current.

There are four well known ways for changing alternating current into direct current, all of which are in practical operation, as follows: By the rectifying commutator, by the mercury vapor rectifier, by the rotary converter and by the motor-generator.

The method for making the conversion depends entirely upon local operating conditions. For small installations, such as a moving picture show, or for charging a battery in an electric automobile, the mercury arc rectifier is generally used. For large installations, such as a street railway system or an electrified portion of a railroad, the rotary converter system is generally used. For intermediate service, either large or small, the motor-generator sets are entirely suitable.

No attempt is made to change direct current into alternating current. When this is at all necessary, in such instances as the ignition system of a gasoline automobile, where current is supplied from batteries, a vibrator is used which gives the direct current a pulsating flow which corresponds in effect to alternating current. Batteries produce only direct current, and can be charged only with direct current. The voltage of a pulsating current can be raised or lowered with a small transformer, or induction coil, just the same as an alternating current.

Submarines utilize storage batteries and electricity for power when submerged.

There are more than 5,000 electric light companies serving the public in this country.

Lighting

A Practical Review of the latest developments in domestic, commercial and industrial illumination.

New Street Lighting---Fixtures---Show Window and White Way Lighting

How a Few Simple Changes Improved the Lighting of a Church

By A. L. Powell

A SMALL church recently modified its lighting system at a very low low cost, yet obtained satisfactory results. here is nothing startling or novel in the design, yet there are many churches which could be improved in similar manners nd made more comfortable, that it seems reasonable to describe e changes. The expense is often the only item standing in the ay of improved conditions, but if one uses common sense, nploying standard material and utilizing as much of the existg wiring as possible, the cost is minimized. It is true that pecially designed fittings should be employed for the very best sults, but this is impossible in many cases, so even if invividuality and elaborately decorated fixtures are not secured, alf a loaf is better than none."

ght view of a church with carbon and gem lamps, giving the least light where it is most needed. The illumination is of too low an intensity and still the lamps consume 5.06 kw.

The particular building under consideration is the First formed Church of East Orange, New Jersey. It has a dency toward the Gothic, consisting of a nave and transept, without a sanctuary. The roof is of wood, stained dark, ghtly arched, approximately 14 ft. high at the sides, rising to 1-foot peak. The walls are of plaster, light cream in color, d the furniture oak. Originally the lighting units were located in the manner shown in the plan. At each corbel was a ee-arm fixture with etched glass, bell-shaped shades. At h intersection of the girders with the trusses, and at the hammer beams, were 6-in. diameter, roughed inside, crystal glass enclosing globes. All of the lamps were 50 watt metallized carbon or gem incandescent.

The system was inartistic, the ball was a poor diffuser of light, and the position of the filament was clearly visible through the glass. The lighting was inefficient for a great percentage of the light was sent upward and the dark ceiling had but little reflective power. In this connection it is interesting to note the comparative brightness of the ceiling and of the pews as in the photograph. Obviously, there was the least light where it is most needed. As a third objection the glare effect was extreme. The bell-shaped shades on the corbels permitted the unfrosted lamp to be clearly visible; but, still worse, there was

Night view of the same church with the new and improved lighting system in place. Note the uniform distribution of light with 17 lamps as against the old equipment of 103 lamps. This new installation requires only 2.2 kw.

a multiplicity of light sources against a dark background in the ordinary field of vision. Anyone sitting in the rear of the church, looking toward the pulpit, could not avoid seeing about twenty bright points. The two clusters at the sides of the choir loft were especially serious. It would be small wonder if the congregation was not fatigued, annoyed, inattentive and restless.

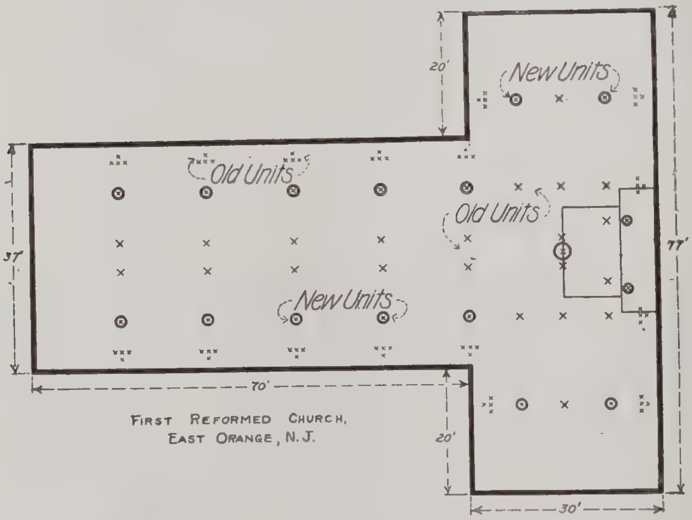
The resultant illumination was fairly even, but of too low an intensity. With the cost requirements mentioned in the open-

ing paragraph in mind, it was desired to improve the appearance, reduce the operating cost and increase the comfort of the audience.

To obtain the best results from a standpoint of efficiency and eye protection, a rather heavy density bowl-shaped opal glass reflector was chosen. This gave a good distribution curve, allowing a slight amount of light to go upward, avoiding a darkened ceiling, yet the intrinsic brightness of the reflector was low enough to avoid annoyance.

The reflector decided upon was the Holophone 10-in. Sudan. Uniform distribution of light could be secured by the use of two rows of lamps arranged symmetrically as shown. In this manner it was possible to utilize the existing wiring without changes; even the holder was suitable, as both the old and new auxiliaries had a 3¼-in. fitter. Bowl-frosted 150-watt Mazda lamps were found to furnish ample illumination.

At the crossing of the nave and transept it was decided to install a unit slightly more decorative. A brushed brass chain fixture, 19 in. overall, with canopy and 6 in. fitter, carried a light density opalescent glass stalactite shape enclosing globe, 10⅜ in. in diameter, 12 in. deep of the same pattern as the direct lighting reflectors. Within this was placed a 200-watt clear mazda C lamp, the equipment being designated as Ivanhoe C fixture. This arrangement provides a somewhat stronger light at the speaker's table, which is a desirable condition in the Evangelical church, as the pastor symbolically requires greater illumination than the rest of the room.



Plan showing arrangement of the old and new lighting equipment in a small church.

To provide adequate illumination for the choir, without the light sources being visible, two outlets on the hammer beams in front of the organ pipes were utilized. Deep bowl aluminum finished steel reflectors, painted on the outside to match the woodwork, with 100-watt bowl-frosted madza lamps, directed a strong light on the books of the choir. The direct light was in this manner cut off from the eyes of the congregation. The large unit at the center gave enough light in an horizontal direction to prevent the faces of the singers from having deep shadows.

In the old installation there were 103 lamps having a power consumption of 5.06 kw, generating approximately 2060 cp. The new system employs 17 lamps, requiring 2.2 kw and giving 2480 cp, but as pointed out above this light is much more effectively utilized. The specific power consumption of the new system is 0.45 per square foot. The estimated average foot candles illumination on the pews is slightly less than 2.00.

It is seen that less than half of the original electric load is required. It would not seem good policy on the part of the central station to encourage better lighting if such conditions always resulted. In this case, however, the church officials were planning to replace all of the 50 watt gem lamps by 25 watt madza lamps. This would have reduced the load to almost the present value, so it is certainly better policy on the part of the company supplying service to cooperate with the customer, as was done in this instance, getting the advertising and creating the good will which results from improved lighting, even if the power is reduced, rather than having the consumer go at the matter blindly and do the same thing without anyone appreciably benefitting.

It is difficult to give actual cost figures on account of the variation of discount on most lighting appliances which depends on the quantity purchased and whether a contractor, jobber or consumer handles the business. As a comparative figure, the list prices are given below. In most cases the actual cost will be considerably less.

FIXTURES	LIST PRIC
1 fixture No. 08241	$15.1
2 A1-100 reflectors	1.6
12 No. 01225-10 in. reflectors	22.5
	$39.2

LAMPS	LIST PRIC
12-150 watt bowl frosted mazda lamps	$13.8
1-200 watt clear mazda C lamp	2.0
2-100 watt bowl frosted mazda lamps	1.4
	$17.2

The labor item was very small, as the only change in wirin was the hanging of the center fixture. In the other cases mere ly the old globes and lamps were removed and the new reflec tors and lamps put in place. Assuming that full list price wa paid for the material, which is very unlikely, then even th total cost would be less than $60.00.

There was a saving of power of 2.7 kw and at the low rat of 10c per kw-hr., this means 27 cents per hour. In other word the installation would be paid for completely in slightly ove 200 hours burning, or in considerably less than a year's time.

A comparison of the old and new systems can be readil made by viewing the two night photographs shown herewit These were taken with the same lens, the same opening, expo ure, development, etc. The illumination on the pews is seen to b greatly increased in the new installation and one can readi decide from the standpoint of appearance and comfort whic would be preferable.

According to the monthly report just published by the ele tricity bureau in the Communications Department at Tokyo ele tric enterprises in Japan at the end of May numbered 615, t combined capital amounting to $303,410,786 United States cu rency. In comparison with the end of 1914 there is an increa of 14 in the number of enterprises and $541,475 in their com bined capital.

Power suppliers make up the largest number of these, bei 524 in all with a combined capital of $154.793.112, while c companies number only 44, though their combined capital $25,520,010. Others number 47 with a combined capital of $12 147,463. The total volume of power generated by them estimated at 727,783 kilowatts, being an increase of 7,551 kil watts over that at the end of last year.

During May four companies were promoted in Hokkaid Niigata, Nagano, and Ishikawa Perfectures with the object carrying on lighting operations. The capital called into use f the promotion of these companies is estimated at $62,897, a total power generated at 267 kilowatts.

A tiny electric lamp on the front porch and another on t back porch, left burning all night, will keep night prowle and burglars away because no thief cares to take a chance the light. They need darkness and black shadows for th protection. One two-candlepower lamp for the front forch, a another on the rear porch can be turned on all night for a fe cents a month, which is cheap burglar insurance.

Comparison of Office Building Lighting Equipments

THIS ARTICLE contains data in tabular form concerning electric lighting service in certain office buildings in the downtown district of Chicago, as compiled by O. Dicker and J. J. Kirk. The buildings were selected as typical examples of lighting installations made thirty, twenty-five, twenty and six years ago; and one which was completed recently. The installations have been taken as they are and treated below.

The lighting of thirty years ago is as absurd today as the business policies of that period are when applied to present-day business. Proper lighting is now generally considered an essential part of factory equipment and an essential item in the reduction of manufacturing cost; but at present the lighting is not generally accepted among business men as an item in reducing office costs. Data showing the reduction of office cost is difficult to obtain, but few engineers would dispute the statement that the working efficiency of a clerk or stenographer is reduced 25 per cent. after sundown in a poorly lighted office. This is the period of the day when the workers are tired and is therefore the period during which their comfort and efficiency should be considered.

TABLE I.—TOTAL BUILDING LIGHT AND POWER

Bldg. No.	Age in years	Connected load kw.	Per-cent load factor	Av. kw-hr. per month	Av. max. per month	Av. net bill per month	Ratio max. connected load—percent.
1	30	100.108	10.45	7,535.8	70.0	$ 388.37	70
2	25	159 210	6.34	7,212:9	63.3	357.52	39
3	20	380.124	7.33	20,062.7	232.4	1,008.75	61
4	6	199.089	13.03	18,241.1	134.4	745.47	67
5	1	342.790	6.38	15,978.7	96.0	610.82	28

In all of the buildings here considered, even the most modern, are installations which the illuminating engineer would refuse to-day to accept as proper lighting; but neverthless they are taken as typical for the purpose of this paper.

It so happens that the oldest building chosen is one in which the owners had foresight enough at the time of its construction to wire for electricity. In the next two, in age, wiring was omitted at the time of construction but soon thereafter it was wired in exposed conduit or wooden moulding. In all three of these buildings the lighting is crude both from point of construction and resulting illumination. The installation has been made without thought or design—a drop cord installed over the desk or table where light was required. At this period electric light was expensive and the minimum amount was therefore utilized. A summary of the lighting of these three buildings shows little or nothing except as a comparative basis. The lighting is localized without reflectors in many cases and where reflectors are found a very cheap and inefficient one has been installed. The lighting is very inadequate. The original installation was of carbon lamps which have now been replaced with tungsten lamps, usually of 40 and 60-watt size. Cluster fixtures as a rule prevail—the most predominant type being a three or four-arm fixture suspended on a rigid stem installed approximately 6 ft. 6 in. above the floor. Wall switches were used occasionally, but as a rule key-sockets have been utilized. The esthetic considerations were not developed, but rather the lighting fixtures were considered a necessary evil and not an ornament.

TABLE II.—RELATION OF PUBLIC LIGHTS AND ELEVATORS TO TOTAL CONSUMPTION

Bldg. No.	Age in years	Total Bldg. kw-hr. per month	Public Lights and Elevators—percent of Total
1	30	7535.8	13.3
2	25	7212.9	64.1
3	20	20,062.7	25.9
4	6	18,241.1	65.8
5	1	15,978.7	67.5

The next two buildings in chronological order show somewhat the effect of the illuminating engineer, at least it may be said that the lighting equipment has been given some attention. The fixtures are more efficient, more ornate, and general illumination has been introduced. The spacing shows a decided tendency away from localized lighting, although in many of the offices, desk lamps have had to be relied upon. Particularly in these newer buildings the individual taste of the tenant as regards his lighting is evident, and so there are seen suites with semi-direct and indirect in all their variations.

TABLE III.—NET OFFICE LIGHTING

Bldg No.	Connected load kw.	Load-factor, per-cent.	Number offices occupied	Av. kw-hr. per office per month	Av, max. per office per month	Av. net bill per office per month	Ratio of max. to connected load—percent.
1	73.748	6.76	88	40.6	0.632	$2.62	75
2	80.960	4.64	80	32.3	0.684	2.17	64
3	307.242	5.22	305	37.8	0.667	2.24	66
4	112.900	4.70	60	64.8	0.936	4.09	49
5	53.901	2 43	31	95.6	1.32	5.82	76

Table 1 shows the total building light and power load together with such factors as influence the cost of such service. The load-factor varies from 6.34 per cent., or 1.52 hours, to 13.03 per cent. or 3.1 hours use of maximum demand. The minimum may be explained by the fact that this building is one in which the lighting was installed after the building was completed and the installation was very inadequate.

The rates for electric service upon which is based the "average net bill per month" is as follows: The building owner buys the electric service for light and power either on a wholesale contract, if the building is of sufficient size, or on separate contracts for light and power but in either case in the buildings here considered, the tenants are individual customers of the lighting company. In the determination of the item of cost the ratio of maximum demand to connect-load is a prominent factor and for this reason it is here included.

TABLE IV.—NET STORE LIGHTING

Bldg.No.	Connected load kw.	Load-factor, per-cent.	Av. kw-hr. per month	Av. max. kw. per month	Av. net bill per month	Ratio of max. to connected load—percent.
1	21.860	18.78	2,955.7	10.4	$116.63	47
2	80.960	4.64	32.3	0.68	2.17	67
3	31.410	14 62	3,307.0	12.6	137.40	40
4	15.311	20.97	2,343.2	9.6	96.41	63
5	68.899	4.32	2,223.2	10.1	92.15	14

The figures giving the total current consumption include that part of the total service which is used for elevators and public light. Public lights include all lighting contained in or around the building which is not chargeable to the tenants, such as corridors, toilets, etc. Elevators include all electricity used for power purposes and the percentage such services bear to the total building consumption is given in Table II. Deducting the consumption chargeable to public lights and elevators, gives the net lighting for offices and stores as shown respectively in Tables III and IV.

It will be seen that the average of the five buildings, gives 73.5 per cent. for public lights and elevators; 17.0 per cent. of the total consumption is chargeable to the lighting of offices and 9.5 per cent. is taken by the store and shop areas on the first and second floors.

The average load-factor of the store lighting is 13.76 per cent. or 3.3 hours as against 4.99 per cent. or 1.2 hours for the office

Table V.—Comparative Illumination

Bldg. No.	Age in years	Total area—sq. ft.	Height of floors - feet	Watts per sq. ft.	Intensity foot-candles	Cost of Light per sq. ft per month
1	30	81600	12	1.02	1 5	4.2 cts.
2	25	110400	12	0.75	2.0	1.8
3	20	340000	17	1.09	3.0	3.1
4	6	95000	18	0.94	4 0	2.5
5	1	106836	18	1.02	4.5	1.6

portion and the ratio of maximum demand to connected load is 49.3 per cent. for the offices, which shows the store to be the longer-hour user, while the office uses a higher proportion of the connected load for a very short time, the former being by far the most desirable load from the central station point of view. The fact that the office uses the lamps for such a short period is probably the reason that the office is the most dilatory to consider lighting improvements; but, as already stated, the time that the office requires light—short though it may be—is the very time that light is most essential.

Table V sums up all the lighting data which hah preceded. It will be noted that during the thirty years there has been little change in the watts per square foot provided, while the intensity has increased with each period and the cost per square foot has decreased. It must be borne in mind that the reason the provided load has not increased during this thirty-year period is because the older buildings were not provided with what is to-day called sufficient illumination, together with the increased efficiency of illuminants. The standards of to-day are greatly in excess of those of previous years.

Where Electric Lamps Are Used

SOME idea of the extensive use of lamps can be gained from the report of the 1912 census recently issued.

The large extent of the use of incandescent lamps is shown by the total estimated number in 1912 of 85,557,819. Of this total 76,484,096 were reported by commercial and municipal central stations combined and 9,073,723 by electric light and power departments of electric railways. The large proportion of the total were reported by commercial central electric stations, which showed 69,428,356, or 90.8 per cent. of the aggregate for all central electric stations, leaving 7,055,740 or 9.2 per cent. for municipal stations. The relative increases in incandescent lamps reported by municipal and commercial stations were not widely different. Incandescent lamps reported by municipal stations gained 156.9 per cent. from 1902 to 1907 and 74.1 per cent. from 1907 to 1912. The corresponding figures for commercial stations were 125 per cent. in the earlier period and 85.7 per cent. in the later period. Different tendencies, however, were shown in arc lamps, where municipal stations increased 63.3 per cent. in 1907 as compared with 1902 and 10.7 per cent. in 1912 as compared with 1907. Commercial stations reported an increase from 1902 to 1907 of 41.2 per cent. and a decrease from 1907 to 1912 of 12.5 per cent. Commercial central stations reported, therefore, a decreasing proportion of the arc lamps shown by the two classes of central stations combined. In 1902 they reported 86.8 per cent., in 1907 the proportion was 85.1 per cent., and in 1912 it had been reduced to 81.8 per cent.

The Middle Atlantic and East North Central States reported 63.2 per cent. of the arc lamps and 53.2 per cent. of the incandescent lamps. Of the total of 76,507,142 "incandescent and other varieties" of lamps a few states reported large individual totals. New York was first with a total of 12,884,911, or 16.8 per cent. of the entire amount; Illinois had 7,375,539, or 9.6 per cent.; California, 6,793,200, or 8.9 per cent.; Pennsylvania, 6,257,665, or 8.2 per cent., and Massachusetts, 4,687,246, or 6.1 per cent.

For municipal and commercial electric central stations combined there was an average of ninety-seven arc lamps per station in 1912 as compared with 118 in 1907 and 107 in 1902. The average number of incandescent lamps per station was 14,649 in 1912, 8792 in 1907 and 5026 in 1902.

The schedule for 1912 census contained for the first time since the census of the electrical industry started an inquiry as to the number of arc and incandescent lamps used for street lighting. Out of the total of 505,395 arc lamps reported by commercial and municipal central electric stations, 348,643, or 69 per cent. were for street lighting. Of the total number of arc lamps used for street lighting, 75.8 per cent. were reported by commercial stations and 24.2 per cent. by municipal stations. Out of the total of 76,484,096 incandescent lamps reported by both classes of central electric stations, 681,379 or 0.9 per cent., were street lamps. Of the total number of incandescent street lamps 474,048, or 69.6 per cent., were reported by commercial stations and 207, 331, or 30.4 per cent., by municipal stations.

Of the total number of incandescent lamps used for street lighting California had 75,802, or 11.1 per cent.; Massachusetts 67,372 or 9.9 per cent.; New York 62,706, or 9.2 per cent., and Illinois, 41,065, or 6 per cent.

The Man Who Invented the Storage Battery

THE ELECTRIC storage battery has come into such general use since the advent of the automobile, the electric truck and the submarine that it is well to remember that its development was due to Gaston Planté.

It should not be forgotten that the chemical storage battery does not actually store up electricity. When the battery is being charged the flow of current causes a certain chemical action to take place in the battery. When the battery is discharged this process is reversed and the chemical reaction sets up a flow of electricity.

Raimond Louise Gaston Planté was born at Orthez, France April 22, 1834. He was educated at the Conservatoire des Arts et Metiers in Paris. His profession was that of a chemist, and his principal work was the investigation of the nature of electrical polarization, which finally led to his discovery of the lead accumulator, which bears his name and has given him his fame.

He was always an indefatigable experimenter, and as a result of his experiments on the discharge of cells, he developed a weakness of vision, which greatly handicapped him and which led, in 1862, to his retirement to private life. In 1860 he was appointed to the chair of Professor of Physics of the Polytechnic Association in Paris.

Plante's best-known work is "Recherches sur l'Electricite," issued in 1879, this covering his contributions to the Academy of Science. An immense number of experiments are described in this book, including those which were made with a lead battery of no fewer than 800 elements. It also included a brief description of his rheostatic machine, for which be received the Academy of Sciences prize in 1881. Planté received the diplome d'honneur at the Paris Exposition in 1881 and was also made a Chevalier of the Legion of Honor. It is said that the name of Plante ought to be handed down with those of Volta and Ampere as among the immortal founders of the science of electricity. Renowned for his modesty and amiability, he never troubled about securing patents during the development of his discoveries—although he was fully alive to their possibilities, preferring to let the world benefit by the additional experiments and discoveries of other scientists. He died at Paris, May 5, 1889.

Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

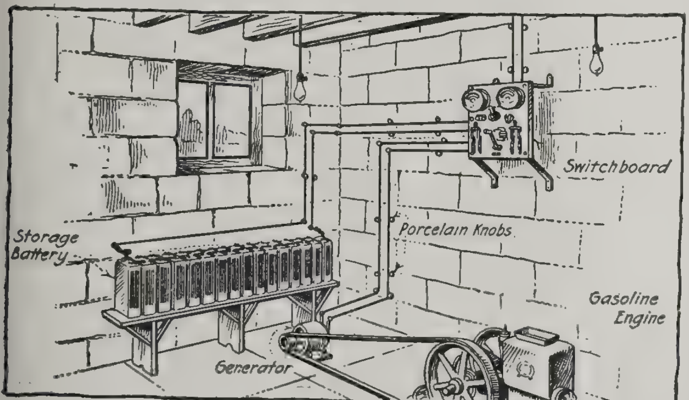
How to Install Storage Batteries

By Frank I. Ellcon

STORAGE batteries are treated as sources of power, insofar as wiring for them is concerned, hence the wiring is subject to the same general regulations as is that for generators, except for the fact that acid fumes are always present in storage battery rooms which renders special precautions necessary.

The methods of wiring must be such whereby the brass or copper of the conductors, which is very readily attacked, is protected from the action of the acid vapors. Wiring of the same general character is required in these locations as in dye houses, breweries, chemical works and similar places, as described in the National Code under Rule 26, i and j. It is probable that the wiring in a storage battery room is subject, insofar as acid vapor action is concerned, to more severe conditions than obtain in any other location in which wiring is installed.

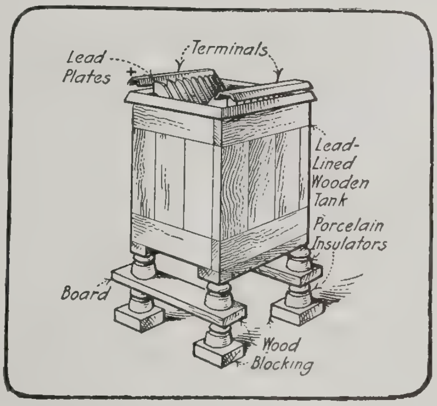
The ventilation of storage battery rooms is imperative for two main reasons. The first and most important is that during the process of charging a storage cell, considerable volumes



A low-voltage storage battery isolated plant for country homes, showing a 30-volt lighting set. When the container of each cell is a glass jar, further insulation of the cells is not necessary.

of hydrogen and oxygen gas are liberated. Unless these are carried off into the outer atmosphere by effective ventilation it is possible for them to unite in proportions constituting a highly explosive mixture. Such a mixture might be explodea by a spark, causing serious damage and possibly a fire. The second reason that ventilation is essential is because the acid fumes from the cells, unless they are carried off into the outer atmosphere, charge the air inside of the room and render it harmful to the health of the attendants and also tend to increase its corrosive action on any exposed metal parts. The acid fumes of a storage battery room do not attack lead, which is the only metal of reasonable cost that can, unprotected, be used in these rooms without danger of corrosion.

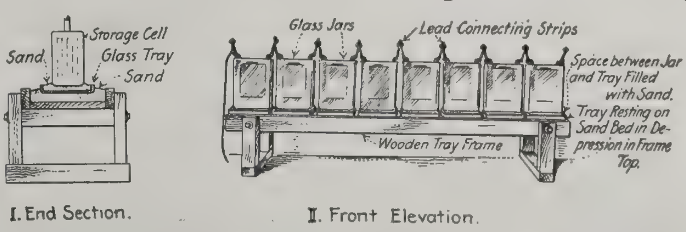
Therefore lead is used for storage cell connections because it is the only metal commercially available that is unaffected by the acid fumes. Where it is necessary that metals other than lead be used in a storage battery room, they must be either protected with lead or by one of the methods described in Code Rule 26j. If unprotected brass or copper were used the acid action would probably so reduce their cross-sectional area that the current for which the conductor was originally installed to carry would fuse it, and might thereby cause a fire or an explosion.



Method of Supporting Storage Cells on Porcelain Insulators.

Storage cells should be mounted on vitrified insulators to minimize the leakage currents that would flow if the cells were mounted directly on ordinary wood supports or on bases of any material that might become saturated with acid. After wood or any similar material has been allowed to remain in a storage battery room for a relatively short time it becomes, in a measure, saturated with acid and thereby becomes a fairly good conductor. Furthermore, a film of acid may form on the outer side of the jars containing the cells, and, even if they are of hard rubber, they provide a conducting path. For these reasons it is difficult to insulate storage cells thoroughly from ground. Experience has shown that glass or porcelain insulators should always be interposed between the storage cell jar and ground. A glass jar for a storage cell is usually considered to provide of itself adequate insulation.

Porcelain insulators used for supporting a large wooden storage cell-tank are shown in the diagram. The insulators,



Method of Supporting a Storage Battery on Glass Trays Filled with Sand.

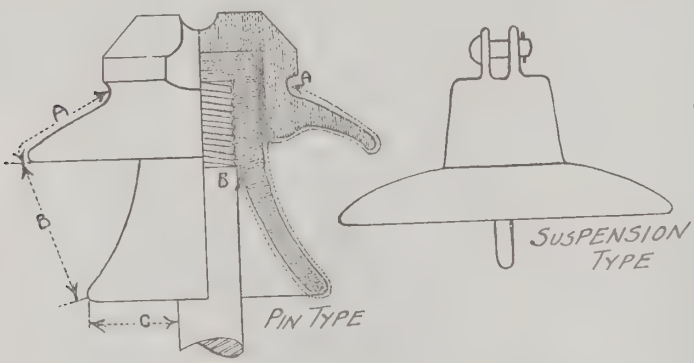
eight in number, are of glazed porcelain of the type used in high-voltage power transmission line construction. Each insulator is supported on a wooden pin, not visible in the illustration, set in the block under the insulator. The top of each insulator rests in a depression in the plank above it.

Glass trays may also be used for supporting storage cells as shown in another illustration. The wooden supporting frame is so constructed that its top surface constitutes a depression, which is filled with sand. On this layer of sand the glass trays are bedded. The sand assures even bedding. Then each of the trays is filled with sand and a glass storage cell is bedded on the sand in each tray. The sand in the trays therefore performs two functions. First, it provides an even bedding for the cell, and second, it collects any acid-laden moisture that may condense and flow down on the sides of the glass jars, preventing it from saturating the sand on the top of the wood frame. It is necessary to change the sand in the trays occasionally. The sand in the top of the frame should also be changed but less frequently than that in the trays. The glass trays in this case may be considered as additional insulators. A complete storage battery low-voltage plant installation is also illustrated herewith.

Some Facts About Insulators

By Henry A. Cozzens, Jr.

INSULATORS may be placed in three classes according to the manner in which they are used on the line. The general form of the pin type as illustrated is attached to the crossarm by means of a wood or iron pin, the conductor being tied to the groove at the top. The suspension or underhung insulator shown, is hung from the crossarm and has the conductor hung from the lower terminal. The strain insulator exists in many



Two Styles of Transmission Line Insulators

varieties and is used to support the conductor when making turns and also with guy wires. For ordinary high tension work the pin type insulator is used but when the voltage is increased above 70 000 volts as in the case of some of our hydroelectric developments, the suspension type insulator is used.

The suspension insulator offers several advantages over the pin type. It has a greater flexibility in high tension transmission since the stresses set up in the crossarms are in the nature of a direct pull as opposed to the twisting stresses set up by a pin insulator, since in the latter the load is applied at the top of the insulator. Furthermore if the conductor were to part, the sag in the nearby spans would be increased and the stresses on the supports or crossarms would be materially decreased as the suspension insulators would not be rigidly supported. There is practically no voltage limit with suspension insulators. If the voltage is increased the insulators may be placed in series, while with the pin type there is a point where the voltage demands an insulator of such weight and size that the cost of installation and maintenance would become prohibitive. More safety is assured as the suspension insulator is less liable to drop the conductor when the porcelain breaks. The cost and weight of this type of insulator lie closely in proportion to the line voltage.

A well designed and built insulator should be arranged for: dielectric strength; mechanical strength; minimum leakage and surface arcing, and ease of erection and cleaning. These characteristics are dependent on the nature of the material together with the design and the manufacture. An insulator may be of the best design but carelessness in manufacture would render it useless for transmission purposes.

Insulators are made from various materials as glass, wood, porcelain and compositions. The glass insulator is generally used for low tension work. As it is transparent, it is an easy matter to detect flaws which may result in the manufacture. It possesses certain disadvantages which make its use impracticable with high voltages, but on account of the results of an extensive study recently made, many will now perhaps advocate the use of glass for high voltages. (See Electrical Engineering for January, 1915).

For high tension transmission, insulators of porcelain are chiefly used. Porcelain possesses peculiar qualifications for insulator construction on account of its ability to be moulded and worked into many different forms. It has a high dielectric strength, and when properly made is of a hard dense construction. Porcelain may be said to be practically impervious to moisture and unaffected by weather conditions, its deterioration due to the effect of the elements is slight. Porcelain is very inelastic but has a good shearing and crushing strength. All these characteristics make porcelain a very desirable material for the construction of insulators in lieu of a better substitute.

Porcelain is manufactured from clays formed of decomposed felspars and granites. There is a wet and dry process for the manufacture of such insulators. The wet process consists of taking the clay in its plastic state and working it into the mould after which it is fired and results in a hard dense mass of high dielectric strength which readily lends itself to use with high voltages. Thus the insulators used with high voltages are usually made by the wet process.

With the dry process, the clay is dried and pulverized and then moistened just enough to retain its shape when pressed into the mould. This does not permit of as dense a structure as that manufactured by the wet process so that this process is limited to insulators for low voltages.

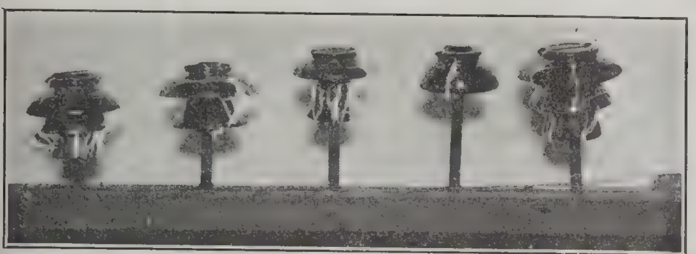
With the large sizes, the insulators are made in section or shells to facilitate manufacture as well as shipment. These parts are later assembled within the factory or on the job and are cemented together. The chief means of doing this is with neat Portland cement of the best grade.

The purpose of glazing an insulator is threefold; the coloring and betterment of appearance, the prevention of dirt accumulation, and the reduction of moisture absorption. The colors usually applied to insulators are brown which is the most favorable, dark blue and slate so as to make the insulator inconspicuous to marksmen and vandals and yet to preserve the general appearance of the transmission line. Oxides of manganese, iron and cobalt with felspar are the chief ingredients of the color glazes. The smooth glossy surface of the glaze prevents the easy accumulation of dust and dirt and makes it possible for the elements to remove what little may adhere to the surface. The action of dirt on an insulator is to reduce the surface resistance and create a leakage path

Since all porcelain is somewhat porous, the glaze forms a coating which prevents moisture absorption.

The design of an insulator may be summarized in two fundementals; firstly, to decrease the leakage. The distance along the surface of an insulator from the point where the conductor is tied to the point of support should be as great as possible. This distance is termed the leakage distance and is represented by the line A-B in the diagram. Secondly, the shortest path through the air between the two aforementioned points should be of sufficient length to prevent a flashover at line voltage, when the insulator is wet. This distance is called the arcing or flashover distance and is represented by the sum of the distances A, B, and C. This should be from two to three times the distance between needle points for the line voltage.

There are several other elements which enter into the design of an insulator and of which brief mention is made. The



High Frequency Dicharge Over Insulators

porcelain should be of sufficient thickness to prevent puncture at flashover voltage. When the ratio of an insulator is mentioned the ratio of the puncture voltage to the flash over voltage is meant. For instance, it is said that an insulator of a certain make has a ratio of 1.7, meaning that the insulator punctures at a voltage 1.7 times as great as the flashover voltage. The minimum ratio for high tension insulators is about 1.35 and the present tendency is for a ratio approximating 2.0.

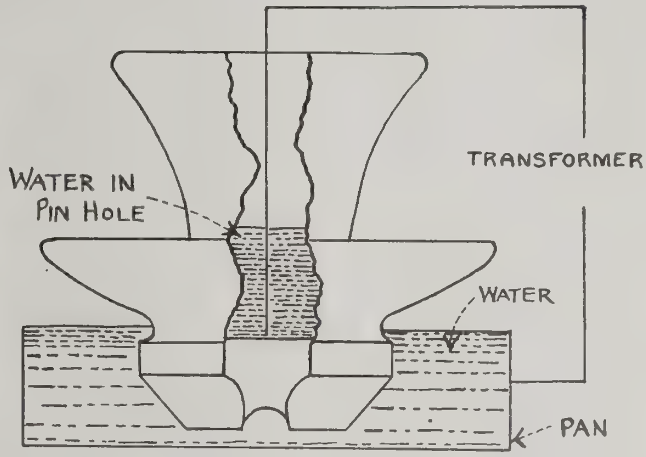
For a given voltage the insulator should be of minimum weight and size, entailing the least expense for manufacture, installation and maintenance.

The insulator has an action similar to that of a condenser and in design is treated with this fact in mind. The effect of capacity enters largely into the design. The flow of electricity over the surface of an insulator is the result of capacity so that to increase the efficiency of an insulator its electrostatic capacity must be reduced. This is accomplished by means of the petticoats and amount of flaring they receive. The original reason for flaring was to increase the arcing distance and this method was later adopted to decrease the electrostatic capacity. The capacity is proportional to the area of the surface, and to the flux constant of the dielectric divided by the thickness of the dielectric. If the petticoats are flared, the thickness of the dielectric is increased and the dielectric flux constant decreased resulting in a reduction of the capacity. The resistance of the insulator is proportional to the length of the leakage path so that if the leakage distance is to be increased, the number of petticoats should be increased. In other words, to an increase in voltage, more petticoats must be added to increase the surface resistance and the petticoats must be flared to decrease the electrostatic capacity.

Insulators are tested for two purposes, proper design and proper production, the latter test being generally applied by the manufacturer before the insulators are shipped. These tests are usually made with commercial frequencies although many public utilities companies are making their own insulator tests by the high-frequency method. When insulators are built up of a number of shells, each part is tested so as to withstand the voltage which that particular part is to carry when the insulator is assembled. The assembled insulator is also tested.

Design tests are made to learn the behavior of the insulator under the most adverse conditions for both mechanical and electrical strength. These tests embody the accumulation of data as to the flashover of the insulator wet and dry as well as puncture under oil and destructive tests to determine its mechanical strength.

The manufacturers' or routine tests are designed to eliminate insulators defective through manufacture. These tests consist of the part test mentioned above and the test of the assembled insulator at a predetermined test voltage for periods of from one to two minutes. The usual method of testing is to insert the insulator inverted in a pan of water up to the middle of the wire groove and then fill the pin hole with water to the depth of the threading as shown.



One Method of Testing Insulators

The wet tests on insulators are termed rain tests. These tests prove to be very unreliable unless extreme care and standardization are effected. Manufacturers do the best possible by accepting standard specifications to which all insulators of their make are subjected, so that a comparison between two insulators of the same make may be of some value. The usual procedure is to effect a precipitation of one inch of water in five minutes on the insulator from an angle of forty-five degrees.

Another form of test is called the dew test. In countries located in the tropics, the insulator becomes chilled during the night and rapid temperature changes in the early morning result in the insulator becoming covered with dew. Tests are sometimes made under these conditions, although a steam test has been devised to replace the dew. It consists of permitting steam to flow out of a hose upon the insulator until it is covered with moisture after which the usual voltage tests are made.

The absorption test is made to determine the amount of absorption and its effect on the insulator. This is due to the existence of hair cracks in the glazing and also the porosity of the unglazed surface. The insulators are submerged in water for about a week and then subjected to the voltage tests.

The general idea of the high-frequency test is to impose on the insulator the conditions which would cause its failure in actual operation due to lightning, switching surges and accidental surges caused by grounds and shorts. The high-frequency or oscillator set consists essentially of a 60-cycle transformer stepping from 110 to 13,000 volts, across the terminals of which is connected a condenser, as is an oscillation transformer immersed in oil. The transformer has no iron core and has a few primary turns and many secondary turns. The voltage is controlled by a spark gap in series with the primary side of the oscillation transformer. These features are now embodied in a set with numerous refinements placed on the market by one of the electric companies.

There are different grades of severity in the application of the high-frequency test and none can be recommended unless the characteristics of the insulator are known. In the company with which the writer is connected, the lines have recently been

reinsulated and it was found by experiment that a test at spark over potential for a period of 15 seconds was very satisfactory. Approximately 25,000 insulators of two types have been tested in this manner.

The salient advantages of the high frequency test are facility of transportation and expedience of testing and accuracy. Practically every failure with the 25,000 insulators mentioned above occurred within the first five seconds after the application of the potential. The set may be readily shipped by automobile to different points and the insulators tested on the job. As many as 1400 insulators have been tested in one day with the services of four men without accident or confusion.

Danger to Life in Touching Grounded Conductors

By H. P. Wood

GROUNDED conductors of electricity are so generally considered to be harmless that that the following notes as to the possibilities of high voltage and consequent danger to life in touching them, are presented.

The earth itself is an electrical conductor, the resistance depending upon the nature of the soil and the moisture present. When two rods or pipes are driven deeply into the earth ten feet apart, the resistance between them may be measured by ordinary methods and there will be a certain drop in potential between them when a definite current is passed from one to the other. The resistance increases practically as the logarithm of the distance. Thus for distances of one thousand and of ten thousand feet, the resistances are respectivley three and four times as much as for a distance of ten feet. If the pipes are not driven deeply or if the moisture of the earth's surface or the nature of the soil is not uniform, it will be readily understood that the above statements will by no means be exact.

Many persons have received small shocks by standing on the ground at the street curb and laying a hand on a steel pole such as is used for supporting the span for a trolley wire. In this case defective insulation has permitted a flow of current from the trolley wire to the pole and through the earth back to the rail. So long as such a defect exists it is evident that the full voltage of the system is likely to be between the pole and the rail. If one assumed that the earth were homogeneous and of equal dryness in the neighborhood, it would be possible to calculate the conditions with considerable uccuracy.

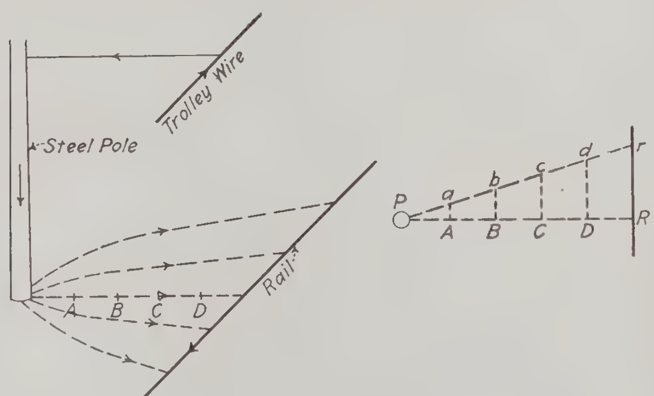


Fig. 1—Grounded Conductors

Figure 1 shows this condition approximately. The curved dotted lines are the probable paths of current from the base of the pole to the track, water pipes, or other conductors in the street. It is evident from this figure that the cross section of the paths through the earth from the pole to the rail increases as we get further from the pole. The resistance consequently gets less and since the same current flows across the successive layers of the path, A-a, B-b, C-c, D-d to R-r, the drop in voltage from A to B is greater than that from B to c, etc. The total drop from P to R is the trolley voltage let us say, 500 volts If we assume that the steel pole is 8 inches in diameter and that it is embedded in the earth ten feet from the nearest rails, and that the trolley wire is accidentally connected to the pole, thus throwing 500 volts on the path from the pole through the earth to the rail, there will be from a point 2 ft. from the center of the pole to the pole, a voltage of 204. From points 2, 4, 6, 8 and 10 feet respectively from he center of the pole, the voltages to the pole are correspondingly 204, 330, 402, 457 and 500. It follows that from points 2, 4, 6, 8 and 10 feet from the rail, the voltages to the rail will be respectively 43, 98, 170, 296 and 500.

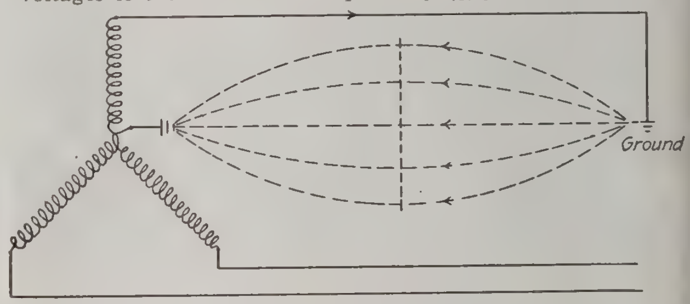


Fig. 2.—Grounded Conductors

The above figures are approximate averages of what might be found but it is not pretented that they are absolutely correct. Due to the fact that current per unit section of the earth is more dense near the pole, the earth will be more rapidly dried near the pole. On account of the loss of energy and heating of the earth, its resistance will increase and the potential drop to the pole will probably be greater than stated above.

The smaller the area of the ground connection the greater will be the voltage to points near it. Had the pole been of 4 in. diameter with other conditions as above, the drop from a point 2 ft. away measuring from the center of the pole would be 263 volts. For grounded connections such as the steel pole assumed in the above cases of 8, 4, 2, 1 and ½-in. in diameter, the voltage to a point 2 ft. away, with the above conditions, are respectively 204, 263, 303, 330 and 352 volts. These latter values are about what could be expected if one touched a pipe ground for a lightning arrester that through defect was connected to the trolley wire, or if one touched a grounded guy rod.

Take the particular case of a high voltage transmission system, let us say of 22,000 volts, with star connected step up transformers and grounded neutral. As in Fig. 2 for example. one wire becomes accidentally grounded to a ½-in. guy rod 20 miles from the station, we have 22,000/ u.c 3 volts impressed on a circuit consisting of the secondary of the transformer, one line wire for 20 miles and the earth for 20 miles back to the neutral connection of the transformer. If the station ground were only ½-in. in diameter. a condition which no operating company would permit, 12700 volts would practically be impressed on the circuit through the earth between the rods, and 6350 volts would be impressed on from one rod to an imaginary neutral plane midway between the grounded points, corresponding to the rail in the former case. The voltage from a point 2 ft. from the grounded rod to the rod would be 1740 volts and would probably prove fatal to a person touching it. Due to the fact that the station ground is usually very thoroughly made to all structural metal, penstocks, etc., the imaginary neutral plane is shifted and the voltage from the assumed guy rod to a point near it is much higher. The heating and consequent drying of the earth near the rod with its attendant increase of resistance will also cause the voltage to be higher and it is unsafe to venture near it until the circuit is killed.

Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Armature and Commutator Troubles

UNDER this heading there appeared in recent issues of this journal, a series of articles by A. R. Knapp. In the August issue L. Thompson offered some notes in discussion of same, and below are given several items on the same subject as a further discussion:

M. Raskin.—In the original article this statement appears:

"In case of wire wound coils, it sometimes happens that one turn of the turns forming the coil becomes twisted during the process of inserting the coil in the slot, and in order to force the coil down to an even depth, the turn of wire will be driven down upon other turns, cutting through the insulation and causing a short-circuit between turns of the same coil. When this occurs the resistance of the coil is reduced, allowing more current to flow, increasing the temperature of the coil and eventually causing a deterioration of insulation on other wires at this point and in the majority of cases, short-circuiting the entire coil upon itself."

Quite frequently short-circuits occur as described in the first sentence. It is true that the resistance of the coil is reduced, but this reduction is very small compared with the total resistance of the armature. When it is realized that the armature resistance does not influence the flow of current more than 5 per cent. at full load and that it is the back emf of the armature that controls the current, it will be clearly seen that the change in resistance can have no appreciable effect on the temperature of the winding. When a turn on a coil becomes short-circuited no part of the line current traverses that section. But there is a voltage induced in the faulty section which causes a large current to flow in this circuit of low resistance. And it is this induced current that causes the high temperature.

In another paragraph of the original article, the following statement is made:

"Sometimes the armature will not start upon the first few points of the rehostat and will then take an excessive current, which will cause it to run with a slow and unsteady motion (especially at slow speeds) due to the fact that every time the short-circuited coil comes under the influence of a pole, it will have a tendency to retard the motion of the armature."

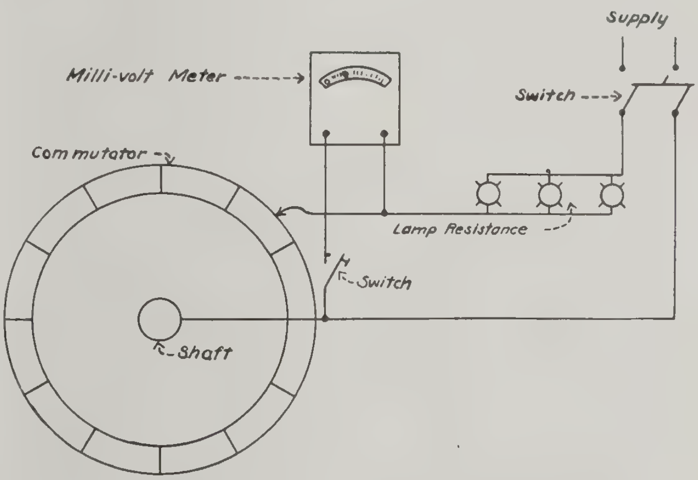
The unsteady motion referred to is not due to a short-circuit in a coil, but is due to a short circuit between different coils in the end connections and in shop talk this fault is known as a "cross."

Under the section of Test and Repairs this statement is made:

"One method of locating a short circuit is to disconnect all the leads from the commutator and test out the coils with a test lamp. A test lamp consists of two wires about 6 ft. long connected to a source of power with which an incandescent lamp is connected in series in the circuit."

If we assume a case of 3-hp. armature 220 volts, which would have about 2 ohms resistance, 99 coils and 8 turns per coil. This will give a resistance of 0.08 ohms per coil and 0.01 ohms per turn. In the original article, as in the paragraph above, it is stated that this difference can be detected by a test lamp, but the author does not prove his statement.

A ground can be located by the method described, but it has become obsolete. The method by which a milli-volt meter is used to locate a short-circuit is a very reliable one, and is used in our shop every day. The way to use a milli-volt meter is



Wiring diagram, showing method of using milli-voltmeter for locating short circuits in commutators.

indicated in the diagram. Place one volt-meter lead and a test lead on the shaft, connect the other two leads together and move them around the commutator; the bars giving the lowest reading are grounded. Care must be exercised that at least one switch is open when the leads are removed from the armature, othrwise the meter will be injured. A switchboard ammeter may be used a low-reading voltmeter, as it measures the drop across the shunt and gives very good results for armature tests; its use is much more common than a milli-voltmeter.

Some few weeks ago the writer had occasion to test a 4-pole wave-wound armature for a ground. A ground on a winding of this type will give two low readings, one being directly opposite the other. The armature had four points of low reading, located about as shown in the diagram. The ends of coil A being connected to bars 1 and 2; the ends of coil B being connected to 3 and 4. As it is somewhat unusual to have two different grounds on the same winding, it is proper to check these indications by some other test before disconnecting. The method used is perhaps original, and is as follows:

One test lead was tied to the shaft, the other was moved around the commutator; a small magnetic compass was held over the coil which was connected to the bar in contact with the test lead. The compass and the lead were kept in the same relative position while being moved. It is easy to comprehend that if the lead is to the right of the ground the needle will be reversed. This reversal is due to the change in direction of the current through the coil in relation to the axis of the armature. The point of reversal of the needle will be at the grounded coil. The leads were disconnected and the winding found to be beyond repair.

H. H. Wikle.—The article on the above subject as well as the discussion on same, are quite interesting. The writer agrees with Mr. Thompson that a short circuit could hardly be called a cause of sparking but rather a result of sparking. However, an open circuit is a very noticeable cause of sparking and one that is often very difficult to locate.

The writer was recently called upon to repair a 6-volt bipolar self-excited plating generator that failed to generate after running a few hours. A test of both the field and armature failed to show an open circuit. After starting and stopping the generator a number of times, a small spark was noticed at the armature end of one of the commutator bars. Examining this bar a loose connection was found between it and the corresponding armature conductor. When the generator was running, centrifugal force opened the connection between the bar and armature conductor and when the generator was standing idle, the conductor returned to its normal position.

On another occasion a low-voltage generator was sparking badly. In the flash of the arc between the brush and commutator could be seen the reflection of an end clip. Examining the reflection as closely as possible so as to be able to recognize it again the generator was stopped and that particular end clip found. As would be expected, a loose connection was found between the commutator bar and end clip.

Since the advent of low-voltage generators and motors into the automobile industry for lighting and starting purposes, a great deal of trouble peculiar to these machines has been experienced. The brushes on these low voltage machines play an important part in their operation, a fact that is often under-estimated and in some cases over-estimated. Some manufacturers seem to think that any grade of brush should operate satisfactorily on their machines, while others think that a poorly designed machine can be remedied by the proper selection of brushes.

While as much care should be taken in the selection of the brushes as is taken in the selection of the other material a great deal of trouble blamed on the brush is often caused by the machine itself. On one occasion the writer was called upon

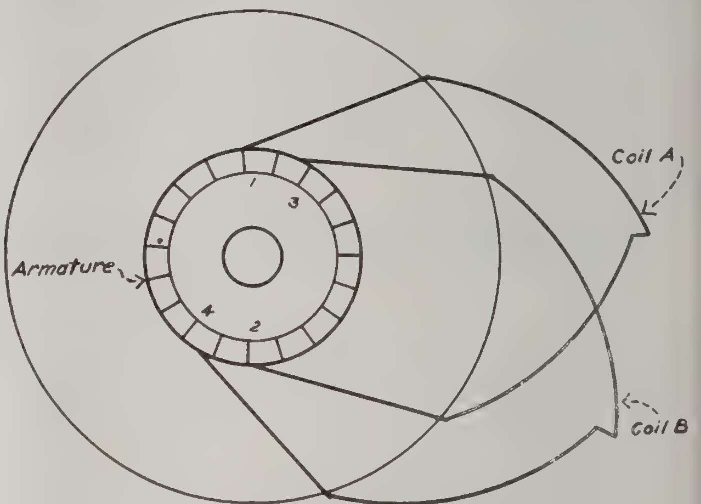


Diagram of defective armature; numbers indicate points of low-reading.

to remedy a supposed brush trouble on an automobile lighting generator. This was about the time the now well known moulded commutator came into the engineering field. The commutator on this generator was of this moulded type and it was found that centrifugal force and the action of heat caused it to distort in such a manner that the brushes sparked badly. When a new commutator was installed the generator gave sparkless commutation with the same brushes that gave trouble before.

Why is There a Difference of Potential?

BELOW are two views on the question of potential difference between a. c. conductors which are completely insulated from ground. In the instance leading to this discussion a lineman received a shock from a 60,000-volt delta transmission line when standing on the ground. In other cases men have been killed under similar conditions.

R. H. Willard.—It is presumed that the difference of potential noted is the potential from line to ground not between lines, for it is the voltage between lines that is maintained by the generators to transmit the power. In an ungrounded system however there exists a static voltage between any line and ground. Its value is normally the line voltage divided by the $\sqrt{3}$ in a 3-phase delta system. In the case mentioned it would be $60{,}000 \div \sqrt{3}$ or about 35,000 volts. The severity of the shock however would depend on the size of the system, length of lines and so forth, for this voltage is really due to a condenser action between the line wires and ground and as in any condenser the quantity of electricity stored is proportional to the capacity of the condenser.

I. L. Kentish-Rankin.—In any high potential transmission line there is always a flow of current due to capacity. The amount of this charging current depends upon the voltage, and frequency of the supply and on the size, arrangement and length of the conductors. Each conductor may be considered as one plate of a condenser and the ground as the other plate. There are thus two paths offered to the flow of current, namely, from phase to phase and from each phase to ground. The effect of capacity, so far as the potential from each phase to ground is concerned, is similar to the effect of connecting a high resistance from each phase to earth. If the system is electrostatically balanced the charging current per phase will be the same; their sum zero, and the system neutral will be stable and at ground potential. In practice it will be found however, with the neutral isolated as it is in this case, that the system neutral will float and a potential will exist between it and ground. It is this potential that the lineman probably received, because otherwise he would in all probability have been killed. If the lineman received full potential from phase to earth the resistance of the earth must have been unusually high, for such cases are nearly always fatal.

The potential to earth, supposing that the system was electrostatically balanced would be given by,

$$E_1 = \frac{E}{2 \cos 30^\circ} = \frac{E}{1.732} = 0.577\ E,$$ which in this case is 34,600 volts.

If attempts are made to measure the voltage from phase to ground, or the star voltage as it is called, it will be found that the voltage will vary according to the capacity and resistance of the circuit. On looking into this it will be found that the following is to be expected:

$$I_c = \frac{E}{R \quad j X_c}, \quad E_1 = \frac{E\ R}{R - j X_c} = \sqrt{\frac{E\ R}{R^2 \quad X_c^2}}$$

where Ic=Current on which depends the constants of the circuit,
E =Generator voltage,
E_1=Voltage to ground, or star voltage,
Xc=Capacity reactance,
R =Resistance between capacity and ground.

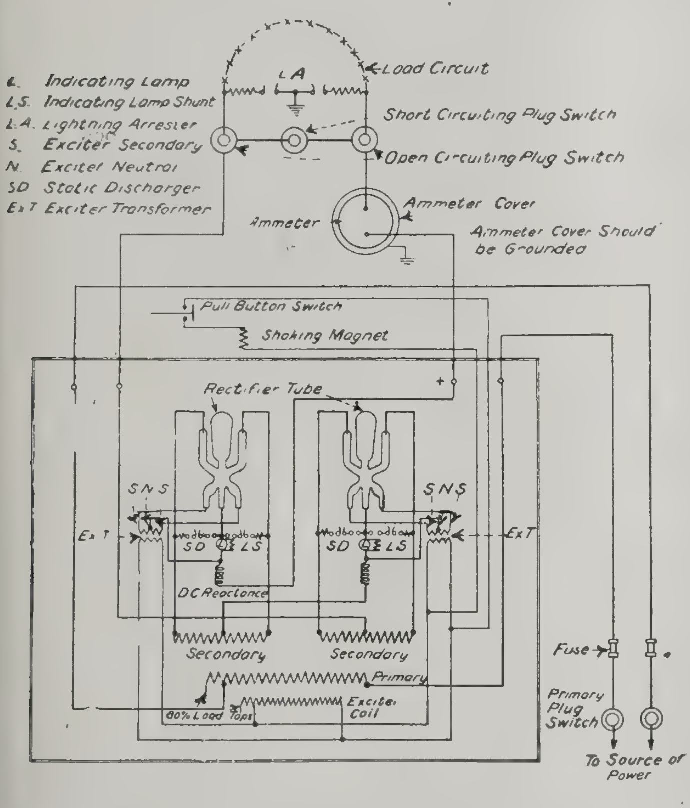
Now, the charging current is very small, Xc very large; therefore, when the values of R are low compared with Xc the effect of R upon R—jXc is very slight, while E_1 is proportional to R. From this it follows that increasing R increases E_1 until at infinite resistance $E_1=0.577$ E.

At the instant of first coming into contact with one conductor the lineman was probably subjected to full star potential of 34,600 volts. The actual value after the first instant does not permit of ready computation, except that it is given by the equation,

$$E_2=Ic\ R_2$$

where E_2=Voltage drop across body,
R_2=Resistance of body,
Ic=Charging current.

That the lineman was not electrocuted seems miraculous, for the current that one would supposed passed through him would have been more than sufficient to kill. The probable explanation is that the current passed through the limbs, and not through the heart.



Wiring diagram of a double-tube type rectifier used for an arc lamp lighting system.

Operating Costs

REGARDING the problem on operating costs in a combined ice and electric plant, the data given is not in sufficient detail to enable one to offer a proper answer. The type of plant, system and methodsof operation, the amount and kind of labor employed would all bear on the question of what one part of the cost would bear to the other. The subject of depreciation is, of course, open to discussion, but a fixed annual charge of 5 per cent. should cover the building and plant; repairs should not exceed 2 per cent. of the total cost; interest may vary from 4 to 6 per cent. according to local conditions; insurance and taxes may be taken as 1½ per cent. so that the total item of fixed charges would be in the neighborhood of 15 per cent. of the total cost of the ice plant which is $20,000. The question of labor, fuel and other supplies for the ice plant will vary under the conditions above named from even as low as 75 cents a ton to $2.50 a ton delivered on the platform. As to the amount of refrigeration required for a cold storage room, this depends on the total exposed surfaces and the kind of insulation used on the roof, walls, and floors; the difference between the temperature of the outside air and the temperature maintained in the room. The best way to arrive at the proper solution is to compute the heat losses on a basis of heat transmission through the materials which make up the storage room.—*J. W.*

Lighting Systems

IN ANSWER to the problem under the above caption, whether a 75-light rectifier set now being used for an arc lamp system and where the system is being changed to series tungsten lighting, the following are offered as suggestions:

Generally the double tube rectifier as illustrated herewith can be used as a constant current transformer by eliminating the tubes. Rectifiers of this type have been going through constant changes so that each individual piece of apparatus is practically an independent design in itself. For this reason no definite information can be given. It is suggested that the querist send the detailed information of the rectifiers he has on hand to the manufacturer from whom they were originally purchased so that they can look up the records and verify the proportions used in the design of same. With such information and with a proper diagram for making connections suitable for a series tungsten lighting system there may be had an appreciable gain in capacity.—*W. J.*

It is perfectly feasible to change a 75-light rectifier used for arc lamps, to operate incandenscent lamps, but in order to do so it is necessary to eliminate all the apparatus excepting the constant current transformer, and the secondary coils of the constant current transformer must be changed so as to operate at standard current, which is 6.6 amp.

The reason why the constant current transformer supplied with a rectifier outfit cannot be operated as a straight constant current lighting transformers is that the coils are wound for low current, and the incandescent lamps are manufactured for a standard current of 6.6 amp. For instance, a 75-light 4-amp. rectifier, connected as in the diagram, with two tubes, supplies approximately 9250 volts to the anodes of each tube; the current flowing in this secondary line is approximately 2 amperes. It is readily seen that the secondary current could not be increased to 6.6 amp. without burning up the secondary coil.—*I. S. Crockey.*

Why the Switch Flashed

IN A power station containing a 550 volt d. c. railway generator, connected by bevel gears to a water wheel it was noted that when the machine circuit-breaker was open there was sometimes a flash when opening the main switch. The circuit-breaker is single pole, the main switch double pole.

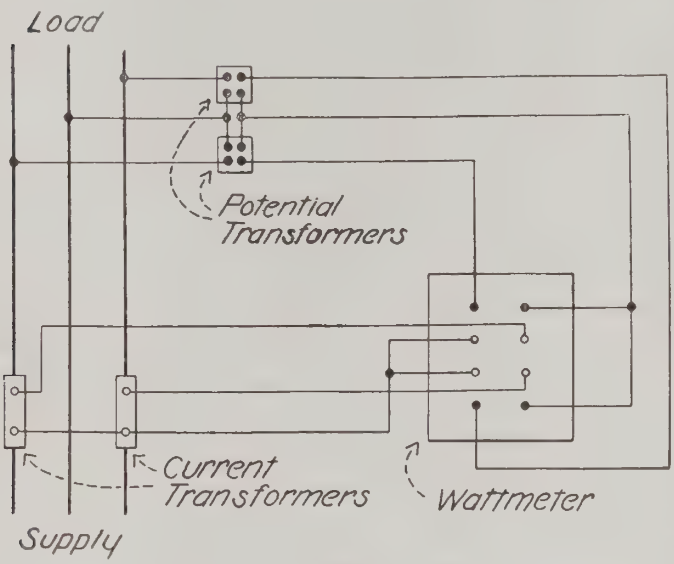
The most puzzling thing about the case was that the switch did not always flash when opened, also the machine carried its load without a sign of any trouble. By observation it was found that there was a ground on one coil in the armature. The machine frame was fairly well insulated from ground by its brick foundation, the resistance being found to measure about 15 ohms from frame to ground.

The machine circuit-breaker was connected on the positive or trolley side, consequently the leakage current to ground was broken by the negative side of the switch. The reason the switch flashed more at some times than at other was because the leakage current was alternating with a frequency of about 12 cycles per second, and the switch would sometimes break the maximum and sometimes the minimum point of the current wave.—*Henry A. Davis.*

Problems for Solution

The following are offered for your discussion. If you have information on these subjects or if you have had experience in these matters, then here is the chance for you to help those in difficulty. Published answers and discussions are paid for.

Ground Potential.—If one leg of a three phase transmission line is grounded as at A in Fig. 1, will a potential indicator give a deflection if suspended from the grounded leg? If the leg that is grounded be isolated, say, 500 ft. from the other legs, will the indicator give deflection? What does the potential indicator show, voltage to gound or between phases?—*U. F. N.*



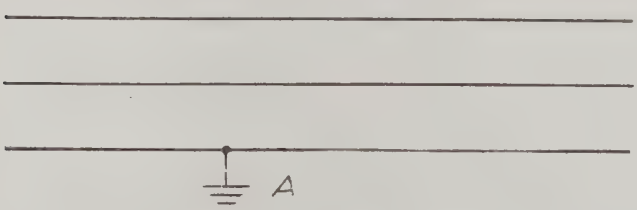
Question on Wattmeter Connections

Telegraphy.—Would like information on telegraph codes, especially the details of the Phillip's code.—*A. P. H.*

Trip Coils.—A coil for tripping a transmission line oil switch in case of trouble is connected in series with the line. It consists of a round coil that has a porcelain sleeve fitting snugly inside, with a laminated iron rod of 1-in. diameter and 3 in. long which fits loosely inside of the porcelain sleeve. The iron core sits on a glass rod or tube about three feet long and extends vertically down to a little trip contactor and in case of trouble or over-load, this makes contact and causes the solenoid to open the oil switch. Please give formula for finding the amount of current passing through coil, and how to figure the turns. The line carries 44,000 volts.—*J. E. M.*

Compressed Air-Motors.—Information wanted on compressed air-motors, especially the revolving type, with diagram illustrating same. Are such motors practical, and are they used to any extent; where can one be purchased?—*F. W. G.*

Wattmeter Connections.—On a 3-phase system with the station wattmeter connected as shown in the diagram, using three wires from the potential as well as from the current transformers, does the meter indicate correctly for all power-factors? The writer understands that it is common practice to connect the low-tension side of the potential transformers to the meter with three wires, while four wires or two circuits are used for the meter leads of the current transformers. If both forms of connections are right, which is to be preferred?—*J. W.*



Question on Ground Potential

Why Transformer Cases Should be Grounded

IN THE October issue of Electrical Age there appeared a discussion on the protection of transformer windings, in which the point of the grounding of transformer cases in relation to the life hazard, was brought up, with a resultant discrepancy in the views expressed. The additional comments by *K. R.*, are therefore presented below:

Engineers are at variance as to whether grounding transformer cases does cause protection against lightning. The subject is somewhat analogous to that of grounding secondaries of several years ago, when a very vivacious and lasting discussion occurred. Tests have been and are still being carried out to determine the exact effect of grounding transformer cases, and it is fairly safe to say that the result will prove beyond all doubt that it is to be highly recommended where lightning is severe and where high-resistance grounds obtain.

A little reasoning will convince one that, grounding a transformer case should be effective. It is not of extreme importance that the lightning potential between transformer windings and ground be kept down to a comparatively low value; on the other hand, it is vitally necessary that the potential difference between primary and secondary and case be kept down. Connecting the lightning arrester from primary to case, and further, connecting the case to ground, succeeds in doing this. Besides the above it has been suggested that the secondary be connected to the arrester and case through a small air gap. With such an arrangement the potential of the transformer may be several hundred thousand volts above ground potential, whereas the potential existing between primary and secondary and case may be, perhaps, only in the neighborhood of eight or ten thousand volts. It can be seen at once that such an arrangement makes the protection independent of the resistance of the earth connection and eliminates the impedance—of which the inductance is by far the more important at the high-frequencies of many lightning discharges—of the wire from arrester to ground.

The actual benefit to be derived from grounding the transformer case and arrester together will vary, of course, and will be greatest where only high-resistance earths can be obtained and where the ground wire must be long. It might here be mentioned that the usual length of a ground wire is about 3 feet, which is amply long enough to offer quite a high impedance to a high-frequency discharge.

Regarding the question of increased life hazards. Many linemen work on 2200-volt circuits alive without gloves, trusting to the insulating properties of the pole for protection against shock. Many companies carefully cover all ground wires running down the side of poles with wooden beading, so as to protect their men from coming in contact with it. The presence of a grounded transformer case, which covers a much greater area than a small wire must constitute a greater risk, areas of wire and case. If transformers are grounded the men ought to be warned that such is the case. It might, as a further precaution, be advisable to insert a link disconnect between cases and the ground wire so that a man may isolate the transformer from ground while he is working on the same pole.

The criticisms by *C. A. Harmon* are well taken, and it is hoped that the above simple explanation will be clear. This matter of grounding transformer cases is not as well understood as its importance deserves. When it is, more transformer cases will be grounded.

Germany's two great electrical manufacturers, the All-gemeine Geselleschaft and Siemens and Halske Co., did a gross business last year of about $170,000,000. Much of the apparatus was purchased by other than European firms.

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

What Others Are Doing

HOW TO increase the sale of electrical current is the vexing problem the commercial manager is always facing. The various ways in which the different phases of such difficulties may and have been met, usually resolve into some form of campaign. The first step is to advertise locally, either by means of show-window displays, newspaper advertisements, circular letters or by a direct-indirect combination of any of these methods.

That this time of the year is a country-wide electrical campaign season, is at once apparent by an examination of newspaper advertising columns. These disclose a variety of methods that are being used by the interests of different localities. Several recent advertisements appearing in such papers are herein reproduced. Some companies feature their service to the public and rate reductions, some are carrying out demonstrations on labor-saving and heating appliances, others are pushing house-wiring campaigns and still others are advocating power installations. As soon as the details of the results of the various campaigns become available, they will be published in this department.

Co-operative Action

Among the many features that are worthy of note is the help extended to the dealers and contractors by the many central stations. As an instance may be cited the work of the New York Edison Company. For the last ten years this company has been publishing the Edison Directory, as mentioned in one of the illustrations, which lists the names and addresses of local contractors together with agents in the electrical business. Copies of this list are distributed gratis, upon request. Several times the company has taken large newspaper space just before Christmas and published a list of names from whom the prospective customer could buy electrical appliances. Also, in their extensive advertising and in circular matter sent out at different times to call attention to special exhibits of new appliances a list of the dealers who handle such apparatus is always included. This work is carried on for the reason as explained by Arthur Williams, general commercial manager of the New York Edison Company:

"We find that this co-operation is appreciated and we certainly think it helps both the manufacturers and dealers as well as the contractors and the central station."

Read This Telephone Conversation:

It's an honest report of a genuine talk, and we can furnish full proofs as to its veracity:

(Central)—"Number, please."

(Phoner)—"2——"

"Yes, that's right. Hello."

"I would like to speak to Mr. Blank. Thank you."

"Is this Mr. Blank? Why, I just called up to ask you how much, in your estimation, the wiring of your house increased the value of your property."

"Increased it 10 per cent., you say. It certainly paid you to have it wired, then, didn't it?"

'And how much did you say it cost you, that is, the complete wiring?"

"Something less than $90. Gee, that's cheap as dirt. know their work is first-class all right."

"Yes, well I'm much obliged. Goodby."

WE DID THAT WIRING

Citizens Light and Power Co.

WHAT WE DO FOR OUR CUSTOMERS

A customer's contract with us is something more than an agreement for the supply of electrical energy—it is also a contract for service.

Our electrical energy is sold by the measured kilowatt-hour—the value of our accompanying service is something immeasurable.

We are supplying, not electrical energy alone, but engineering advice and efficiency facilities such as are seldom offered free of cost.

This service is not specified in our contracts—we have no desire to limit in any way the extent to which our customers may use it.

If your lighting or power problems have outgrown your experience, telephone to us for free advice and assistance—the response will be prompt.

B.C. Electric

Hastings and Carrall Sts. Phone Sey. 5000.

WIRING THE OLD HOME

The younger generation crave the comforts and conveniences afforded by electricity.

There is no necessity to tear down the old home with its many associated memories in order to have them.

Our workmen will make a dirtless and mussless job of the wiring in jiffy-time, and change the Old Manse into a thing of beauty and comfort.

"The Light House"
JAMESTOWN ELECTRIC CO.
119 East Third Street

House Wiring

Because the long evenings are now at hand and the holidays are approaching, house wiring campaigns are certainly timely. As an example touching on this phase of the subject, one of the Rockland Light & Power Company's advertisements is given in part: "You will surely regret it if you don't have your house wired in time to enjoy electric light during the coming holidays. There is something bright and cheery about electric light that makes it just the thing for the season of hospitality and good cheer."

Among the many pointers featured in the advertisements of the various public service companies the following phrases have been culled, and these may be of interest:

Electrically lighted houses are cheerful.

Electric light means comfort and economy.

No house is too old for electric wiring.

Electrically lighted homes rent quickly.

Electric light in your home is the greatest enemy of the thief.

Electric light is soft and restful.

Lighting by electricity is the most convenient way.

Our rates places electric lights within reach of all.

Electric service means city conveniences without city expense.

So You May Know

How easily, quickly and economically your home can be wired to do your housework

Electrically

First, the workman locates his Meter Board, and then begins to plan just how the entire "job" is to be done. The meter is generally located in the cellar in such a place that the main leads can be easily and quickly extended to the desired location. The wires are "fished" through the walls and as a result all wiring is concealed. The main leads are extended as is shown in the illustration to such a point that all the outlets, including lighting, switch and baseboard, can branch from this main "Lead." Very little trouble is experienced in this way.

We have arranged with the Fisher Electric Co. and the Lewis Electric Company to wire your home at a very low cost. Let us tell you how low it is.

The Massillon Electric & Gas Co.

PHONES—BELL 5; OHIO 112.

Perhaps the most important item in house wiring is the installation proper, not so much the cost of the work but the manner in which it is carried out in houses already occupied. In the illustration showing the advertisement of the Massillon Electric & Gas Company, it is made clear that electric wiring, properly installed, is a dirtless job that can be done in a short period of time without trouble to the owner.

Many electric companies in their house wiring campaigns are also featuring the installment on part-payment plan for wiring systems to be either installed by them or by an outside contractor. Following are some of the plans as they appear in newspaper advertisements:

A neat serviceable installation of wiring and fixtures for an eight room house will be placed for approximately $40; to be paid at $3.25 a month for twelve months in addition to the moderate current charges.

We accept payment in ten equal installments for wiring any house on our lines. A four room house will cost $20; a five room house $25; a six room house $30. These figures include all materials, workmanship, fixtures and everything ready to press the button.

We offer to do the wiring necessary for the installation of electric light at the lowest ratio of cost ever figured provided the contract is made before .... (date). The bill for the work to be divided into 24 payments—one each month with the light bill.

We will wire three rooms in your house—parlor, dining room and kitchen—and give you a coffee percolator and an electric iron at the special price of $11. If the account is paid within five days after the current is turned on a discount of one dollar will be allowed. But that is not all! If the percolator is not wanted deduct $2.50; if the iron is not desired deduct $1.50. Then think of it! You can have your home wired in the above mentioned manner for the unheard-of low sum of $6.00. We guarantee quality of wiring and materials, work being covered by a Fire Underwriter's inspection. Offer remains open until November 15, and applies only to already built and occupied houses in our lines.

Modernize the house, wire for electric lights. The cost is low and there is six month's time for you to complete payment for the work. Special on wiring for 4-room house $16.50; 5-room house $20; 6-room house $25. This is a special six-week offer.

About Home Wiring

Many have intended from season to season to give their families the benefits of electricity in the home, in light, for convenience and decoration, as well as for utility, and in all of the electrical labor-saving appliances, which eliminate domestic fatigue and assist in solving the servant problem

There are a large number of established electrical contractors in this City who specialize in home wiring whose names and addresses are included in "The Edison Directory" —sent to anyone upon request

The New York Edison Company

At Your Service

General Offices: Irving Place and 15th Street
Telephone: Stuyvesant 5600

Branch Office Show Rooms for the Convenience of the Public

424 Broadway	Spring 9890	*124 W 42d St	Bryant 5262
126 Delancey St	Orchard 1960	*151 E 86th St	Lenox 7780
10 Irving Pl	Stuyvesant 5600	*27 E 125th St	Harlem 4020

*362 E 149th St Melrose 3340

*Open until Midnight

Night and Emergency Call Madison Square 6001

Electrical Equipment.—United States firms have furnished over 40 per cent. of the electrical machinery and supplies used in Brazil, but not through any concentrated effort. It was because the street railway and light and power systems in various cities are under the management of Americans.

Electrical Appliance Display

A seasonable display, easy to install, is shown in the photograph. A large panel card, embellished with flowers and foliage, has inscription: "Wire Your Home for Electric Service. It insures Real Comfort all Year-long." This is fastened on the background or hung from the ceiling with fine wire. Smaller cards read: "Cook with it"—"Clean with it"—"Light with it"—"Iron with it"—"Wash with it." At one end of the display an electric range is placed, and at the other end a washing-machine. A unit of lamp cartons, lamps on pedestals and glass shelf is used as a center-piece. Cooking devices of various kinds and electric irons are arranged in the foreground. An electric fan in the middle, etc., and other appliances as shown.

How the Window Display Stimulates Sales

Features for the Jobber, Dealer, Contractor and Central Station

WITH the widespread propaganda of the Society for Electrical Development to make the week of November 29 to December 4 one which will promote and increase the use of electricity for all purposes it can hardly be denied that public interest in things electrical will be quite intense. The time, appropriately called Electrical Prosperity Week, has been well chosen, coming as it does, just after the commencement of the Fall season and directly following Thanksgiving Day, leading into the gift-buying period of the holidays to come. To reach the public, some form of advertising must be resorted to, and it has truly been said that the window display is the last link between every form of advertising and the actual purchase.

An extensive increase in sales may be gained by giving some additional attention to the show-window. Many people buy things because they need, or think they need them, but most people buy because good window displays remind them of real wants and create wants that did not exist before. Here are shown two timely suggestions for the kind of displays which give 100 per cent. value out of the show window.

Lighting Glassware Display

This window offers a suggestion as to the manner in which shades and reflectors may be shown in an artistic manner. On the background are arranged artificial flowers in Fall colors as shown; a dark green hanging is used for a background in order that the white glassware may show to advantage by contrast of color. These hangings may be of velour, sateen or other goods, or of wallboard painted a dark green. An electric light should be used in each of the large shades or domes, to bring out the pattern and beauty of the piece when lighted. The card in the foreground reads:— "Electric Lighting Fixtures to conform with every architectural design." Exercise care not to overcrowd the display.

Why Individual Industries Build Private Plants

IN THIS article is considered the problem of privately generated power versus purchased central station current for industrial plants. The comments and figures are from a paper read by H. B. Emerson before the seventh annual convention of the New England Section of the N. E. L. A. The author points out that many of the New England industries are so situated that they have water power available; others have to use steam in the various processes of manufacture at low pressure and by tapping the receiver of a compound engine or by bleeding the secondary stages of a turbine which they use for power purposes, they can produce their current at a very cheap rate. The New England section is one of the hardest for the field of the central station even though coal costs are high. Statistics show that there are more small water power privileges here per square mile than in any similar area in the United States.

In this section of the country, therefore, power can in many instances be generated more cheaply in the private plant and because the isolated plant owner has absolute control over this power, the individual industries build their own power plants instead of purchasing power from the central station. A number of private plants are actually producing a kilowatt hour at a cost of from ¾ cent to 1 cent and these figures include the fixed charges covering interest, depreciation, insurance and taxes on the plant, as well as the operating cost.

Operating Costs		Fixed Charges	
8,595 tons Coal	$40,826.25	Depreciation, Building 2%	$ 1,500
Boiler Room Labor	2,850.00	Depreciation, Equipment 5%	7,250
Turbine Room Labor	2,950.00	Taxes and Insurance 4%	8,800
Supplies, Repairs, Renewals	3,146.00	Interest at 6%	13,200
Total Operating Costs	$49,772.25	Total Fixed Charges	$30,750
Cost per kw.-hr.	$0.00497	Cost per kw.-hr.	$0.00308

Table of operating costs in a 3,700-kw. turbo generator isolated plant.

Assume a plant requiring 10,000,000 kw.-hr. for a year of 2,730 working hours. The power unit is a 3,700-kw. turbo generator consuming 16.26 lb. steam per hour at full load; to be on a conservative basis, say, 16.5 lb. per hour at 3,660 kw., which is the average load. The auxiliaries require 10 per cent. as much steam as the generating unit, and for banking the fires on nights and Sundays requires an average of 15 per cent. of the total coal used. The average evaporation of the boiler plant is 9.5 lb. of water per pound of coal and the second stage of turbine is bled to feed processes of manufacture at a pressure of 5 lb. per square inch; an average of 30,000 lb. steam being used per hour. Thus 3,660 kw. times 16.5 lb. steam gives 60,390 lb. steam per hour with turbine running normally. With 30,000 lb. being bled from the second stage, only 12 per cent. of same or 3,600 lb. per hour is chargeable to the power end. (Tests show that 88 per cent. of the heat value is retained in the low pressure steam). Then

$$\frac{3600 \text{ lb.} \times 2370 \text{ hr.}}{9.5 \text{ lb.} \times 2240 \text{ lb.}} \times 1.10 \text{ for auxiliaries} \times 1.15 \text{ for banking} = 584 \text{ tons of coal}$$

Also, with 30,000 lb. steam going through the first stages of the turbine, it will generate 668 kw. The average load of 3,660 kw. minus 668 kw. obtained by steam to low pressure, leaves 2,992 kw., and

$$\frac{2992 \text{ kw} \times 16.5 \text{ lb.} \times 2730 \text{ hr.}}{9.5 \text{ lb.} \times 2240 \text{ lb.}} \times 1.10 \times 1.15 = 8011 \text{ tons of coal.}$$

The total cost, therefore, is equal to 8011 × 584 or 8,595 tons, and costs $4.75 a ton delivered in the boiler room.

The power house building costs $75,000, and the plant equipment with auxiliaries costs $145,000, or for the complete private generating station an aggregate of $220,000. The operating costs and fixed charges are as shown in the tabulation.

If a central station should have approached the management before the plant was installed and offered to sell power at 1 cent per kilowatt hour, it could have made little impression on the owners in the face of a saving of $19,500 by using the privately generated power even though it entailed an expenditure of $220,000 to erect the plant.

The reasons heretofore stated have been given solely from an engineering standpoint. There are undoubtedly, however, other reasons why central power is not used to a greater extent in New England, the principal one being that many industries do not know what their power actually costs them, believing it to be much less than it actually is. Some figure only the coal, the labor for feeding same to the furnace, and the attendance and supplies to the generating equipment. In many cases the fixed charges are enough to double this figure and in such cases experience and central station education is the only answer.

Unique Street Lighting Fixtures

CLOSELY connected with the Indian legends of California is a peculiar scar on the mountain side near San Bernardino which takes the form of an arrow head. This symbol has been adopted as the permanent design of the ornamental street lighting system of the Gate City.

The lighting fixtures are each four feet wide and six feet long, being mounted on galvanized posts eight feet high. Ranged on either side of the arrowhead are 14 10-watt Edison mazda lamps, while the top is surmounted by a 12-inch round globe illuminated by a 60-watt lamp. The blocks in San Bernardino are 600 feet long, and 10 of these fixtures are ranged five on on each side of the street, and spread an even glow over the entire length of the block, penetrating every shady spot caused by the trees in the yards, and giving the street all the illumination necessary at very little expense. The plan is to burn all the lights in the fixture from dark until 11 o'clock, and to operate the top light only during the balance of the night.

Why the Generator Would Not "Pick-up"

ONE OF THE conditions required in order for a direct current generator to "pick up" its field that the brushes make good continuous contact with the commutator. There have been instances where a commutator has taken on such a high degree of polish, that it was necessary to slightly sand paper the commutator in order to remove the high resistance glaze that was preventing the low voltage, due to residual magnetism, from producing an initial field current flow. High micas and, on high speed machines, high bars or an eccentric commutator, may be the cause of failure to generate because the ununiformities produce vibrations that prevent the brushes from making continuously good contact with the commutator. That the same trouble may be due to vibrations incident to other irregularities, is indicated by the following:

An operator of a high speed direct connected turbine driven generator, allowed an armature box to run hot and the shaft was so badly cut that it had to be turned down and linings of smaller diameter used. On reinstalling the rotor it was found impossible to make the generator "pick up," although it would develop normal voltage when excited from another machine. The connections and the polarity were checked and found to be regular. The operator was experienced in locating all kinds of ordinary trouble but he was unable to locate this particular brand; so he returned the machine to the makers for a general overhauling. The tests had similar trouble getting the machine to "pick up" but they noticed that there was considerable vibration at the higher speeds and searching for the reason revealed the cause of non-generation; the bearing had been reduced so much that the shaft whipped.

Replacing the shaft eliminated all troubles.—*E. C. Parham.*

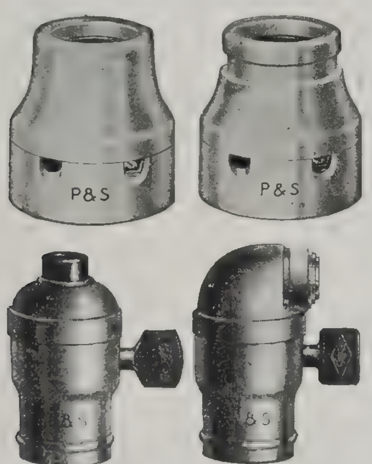
New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

Lighting Specialties

SOME NEW devices that are now being placed on the market by Pass & Seymour, Inc., Solvay, N. Y., are shown in the illustrations herewith. The receptacles are designated as P. & S. 599 and P. & S. 598 and come respectively with and without shade holder grooves. These are neat porcelain receptables brought out to meet the demands of the trade. They have concealed terminals for open work on loom-box work and in fact allaround wiring requirements. A half-inch recess in the base takes care of loom ends or other conditions requiring a deep base.

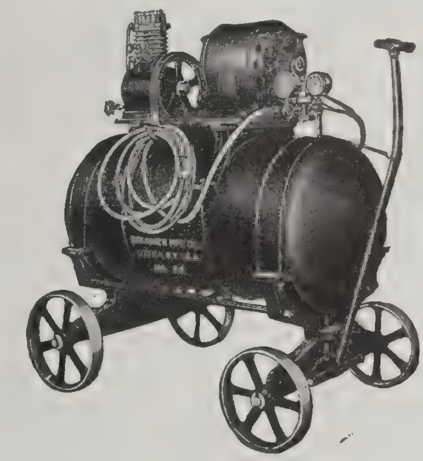
The Strain Relief Cap as illustrated can be fitted to more than a dozen of the brass-shell devices turned out by this manufacturer. It is designed to relieve the terminals from the strain incident to pendent or drop cord work on sockets, switches or switch-rosettes. The cost of such specialties is the same whether fitted with the strain relief cap or not.



RECEPTACLES WITH CONCEALED TERMINALS, ABOVE; FIXTURE CAPS, BELOW—PASS AND SEYMOUR, SOLVAY, N. Y.

Portable Cleaning Outfit

A PORTABLE compressed-air outfit for the purpose of blowing the dust out of electric motors and generators in industrial plants is being made by the Brunner Mfg. Co. of Utica, N. Y. It is designed especially for knitting mills, wood working plants and large bakeries where dust or foreign matter as related to the machinery will accumulate very easily. The outfit is equipped with a seamless steel air tank mounted on a heavy iron truck and on top of the tank is placed an iron platform on which is mounted a two cylinder vertical air-cooled compressor of 2½ feet per minute capacity. The compressor is geared to a ½-hp. compound wound direct current motor or hp. single phase 60 cycle, 110 volt, repulsion-induction type a. c. motor, as the conditions may require. The net weight of the outfit is 500 lb. and the shipping weight is 650 lb. A push button valve is supplied on the end of the hose line with three different size tips to fulfill the requirements of different classes of work. In industrial plants one may, by systematic work, easily keep all motors and generators clean by the use of this machine for only a few hours during the week. In such plants where motor driven machinery is used extensively this outfit would prove a most profitable investment.



PORTABLE OUTFIT FOR CLEANING MOTORS AND GENERATORS—BRUNNER MANUFACTURING CO., UTICA, N. Y.

Battery Charging Outfits

BATTERY charging outfits designed especially for service in garages for charging automobile ignition and lighting batteries, consists of small motor-generator sets on which are mounted small switchboard panels bearing all the switches, instruments, etc., necessary for their control. They are to be connected to the incandescent lighting circuits by means of lamp cord and plug, the motor-generators being supplied for service on 110 or 220 volt, 60 cycle, alternating current circuits, or on 110 or 220 volt, direct current circuits.

The motor-generators are supplied to deliver direct current at 12, 18 or 20 volts, such voltages being specifically adapted for charging 12, 18 and 24 volt batteries.

The switchboards, which are mounted upon these sets, have a snap switch in the line circuit for the purpose of starting and stopping the sets; a snap switch in the circuit from the generator to the batteries to be charged, for opening the charging circuit; a voltmeter for reading the voltage delivered by the generator; an ammeter for reading the charging current; and a field rheostat for raising or lowering the voltage of the generator end of the set and, therefore, serving to adjust the battery charging current. A small push button switch placed in the center of the board between the two snap switches before mentioned, is provided so that the voltmeter is not in circuit except when it is desired to read the voltage delivered by the set. The rheostat provided on the switchboard in all cases has sufficient capacity to reduce the voltage of the set to that proper for charging a battery of any lower voltage down to and including a 6 volt battery.

These battery charging outfits are so small that they may be placed at any convenient point in the garage, and when placed upon a work bench they will take up but very little room. They need practically no attention in service other than an occasion-

al filling of the bearing grease cups with oil. The switchboard, bearing all of the instruments, rheostats, switches, etc., properly wired leaves as the whole work of installation, simply the necessity of connecting to lighting circuit and to battery by lamp cord. The outfits are supplied in two capacities, 175 and 250 watts output, such capacities having been found specifically adapted to the service of charging automobile ignition and lighting batteries. The outfits above described are manufactured by the Fort Wayne Electric Works of General Electric Co., Fort Wayne, Ind.

Bowl Type Reflector—Harvey Hubbell, Inc., Bridgeport, Conn.

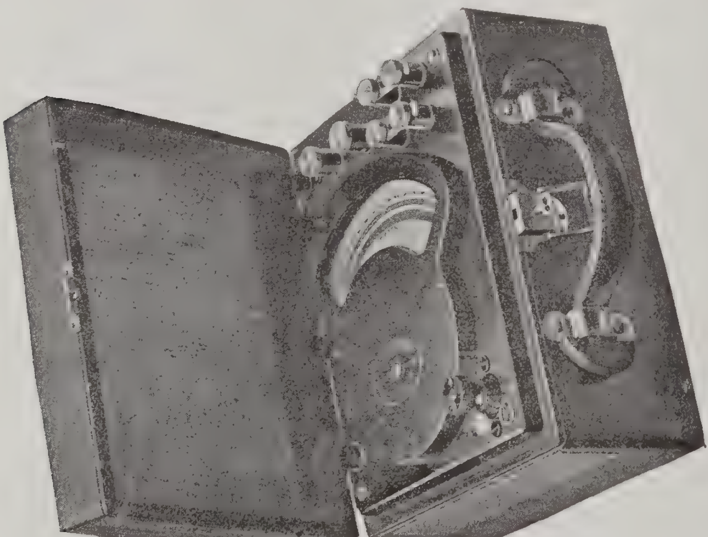
Bowl Type Diffusive Reflectors

TWO new 6-inch bowl type diffuse reflectors were recently placed on the market by Harvey Hubbell, Inc., Bridgeport, Conn.

These shades were primarily designed to meet the requirements of the industrial trade, being particularly adapted for bench work. The maximum efficiency is obtained when used in connection with 25 and 40 watt lamps, the neck being so arranged that when the lamp is inserted a considerable radius is illuminated and at the same time the strongest light is concentrated directly beneath the unit.

One type is finished with a heavy coating of porcelain enamel, green outside and white inside, providing a high reflecting surface.

The other is a painted shade, finished green outside and aluminum inside and is more desirable on installations where the reflector is subject to rough usage. Both are of heavy steel and euipped with the Hubbell Contractile collar, making the use of separate shade holders unnecessary and assuring absolute center suspension.



Portable Single-Phase Wattmeter—Weston Electrical Instrument Co., Newark, N. J.

Measuring Instruments

A NEW line of measuring instruments has just been developed by the Weston Electric Instrument Co., of Newark, N. J., which marks a distinguished advance in the science of electrical measurement. Among these are the a. c. and d. c. electrodynometer ammeters, voltmeters, wattmeters and both single phase and poly-phase electrodynamo-meters. In the illustration herewith is shown a model 310 wattmeter which is typical of the new portable instruments above enumerated. Problems heretofore considered impossible of solution have been solved in the designing of these instruments. They are the latest development of their particular type, and embody characteristics never attained. These instruments are guaranteed to an accuracy of ¼ of 1 per cent. scale value of d. c., or a. c. circuits of any frequency. Their movable systems have an extremely low moment of inertia and are very effectively damped. Indications are independent of room temperature, the heating effect of current passing through the winding of the instrument, and the instruments are shielded from external magnetic influences. For complete information regarding any of the above instruments write to the manufacturer for bulletins descriptive of same.

A Combination Insulator

THE INSULATOR herewith illustrated is a combination cable insulator and splicing sleeve for under-ground work. It is manufactured by the Drew Electric & Manufacturing Co., Indianapolis, Ind. When used as an insulator in the cable sheath, it will destroy the conductivity of the sheath by dividing it into short sections and prevent its collecting current from earth and under-ground structures. When used as a splicing sleeve it eliminates the danger of leakage at the splice, as the insulator will stand against any voltage. This form of insulator may be also used in manholes entering buildings, or to separate cables

Combined Cable Insulator and Splicing Sleeve, Shown Assembled and Partly Disassembled—Drew Electric and Mfg. Co., Indianapolis, Ind.

at or near switchboards or in power houses. The factor deciding the number of such insulators that may be necessary for any installation is governed by the conditions to which the cables are exposed and the number of places where it may be necessary to separate cables from each other. In the illustration showing the partly disassembled insulator, the figures refer to the following: 1—Cast brass tubes tapered and threaded into the malleable end castings numbered 3; 2—Openings for filling joints with insulating compound; 3—Malleable iron end castings leaded onto the middle section numbered 4; 4—A 12-in. porcelain tube with three-quarter in. wall thoroughly glazed inside and outside.

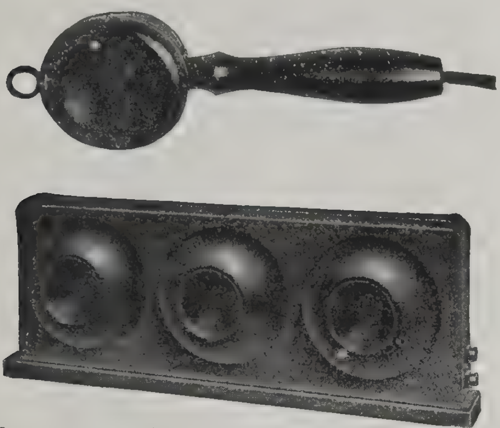
Telephone Equipment for Churches

A NEW type of telephone apparatus on the market, will be most useful in churches, lecture halls, and theatres where the acoustic properties are poor or where there is among their audience men and women whose hearing is not normal.

The equipment which has been developed by the Western Electric Company, 463 West St., New York, consists of a special telephone transmitter for mounting on the pulpit or platform and receivers to be used by those in the audience requiring them. The transmitter consists of three special microphone transmitter units in an ebony finished case. The receiver is the ordinary watch case type with a lorgnette handle provided with a special sliding extension to vary its length from four to seven inches. This receiver is convenient to use; it may be held to the ear for any length of time without fatigue.

Each receiver is provided with a cord and plug. Jack which is connected to the line leading to the transmitter is placed in the pews. When the plug attached to the receiver is inserted

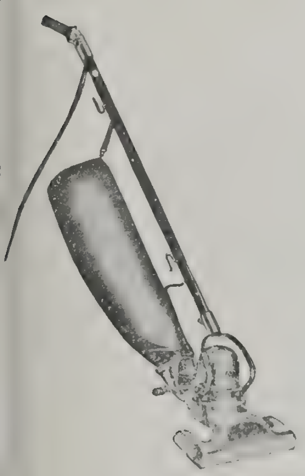
in the jack, the user is in a position to listen via telephone to everything that transpires on the pulpit or stage, no matter where he or she may be sitting. Although the apparatus has been designated Church Telephone Equipment it can be used equally as well in theatre or lecture hall.

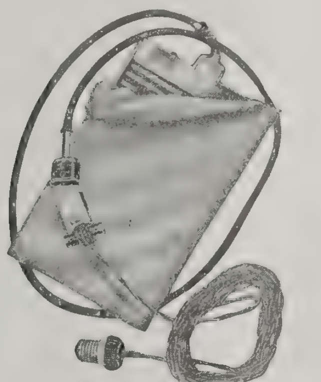


NEW TYPE OF TELEPHONE INSTRUMENTS—WESTERN ELECTRIC COMPANY, 463 WEST ST., N. Y.

A Motor Driven Churn

A RECENTLY developed line of motor driven metal churns is now being marketed by the Dazey Churn Manufacturing Co., of St. Louis, Mo. The type of churn shown in the illustration has a gross capacity of 28 gallons and a churning capacity of 18 gallons being operated by a one-quarter horse power motor. The nachine is operated by the motor in conjunction with especially designed paddles which drive the cream and break up the natural globules into grains about the size of rice. The process of churning removes the liquid so that the butter does not have to be worked, requiring washing only, after being made.





VACUUM CLEANER AND FLEXIBLE HOT-PAD. — HOTPOINT ELECTRIC HEATING CO., ONTARIO, CALIF.

Flexible Electric Hot-Pad

A HOT-PAD that will successfully overcome the most obstinate objection to substitutes for the old time hot-water bottle; the danger of burnout in electric flexible cloth hot-pad, and he inadaptability of the stiff metal electric hot-pads for some ıurposes, leaves little to be desired for true comfort, when a hot pplication is required.

After many trials and experiments the Hotpoint Electric Heating Company, of Ontario, California, has placed on the narket a metal flexible electric hot-pad which they vouch to be bsolutely safe and in every respect an unsurpassed improvement over all other methods of dry local heat application to the ody.

Hotpoint Safety Comfo, as this hot-pad is called, operates from any lamp-socket and consumes but 49 watts. Its graduated heat regulation permits the operator to enjoy any temperature from 100 to 200 degrees F. by simply moving a small lever; this is so arranged to enable its operation in the dark or under the bed-covers. The temperature is automatically retained by a thermostat. It is flexible in so far as metal permits—consists of eleven hinged or interlocked units which form a metal packet or case (6¼x10½x½ in. thick over the wire-wound mica heating element inside. It conforms to the body curves or may be wrapped around a limb. Hotpoint Safety Comfo is furnished with a washable eiderdown pad which slips over the metal case, affording a soft soothing surface to the skin.

MOTOR DRIVEN CHURN — DAZEY CHURN AND MFG. CO., WARNER AND CARTER AVES., ST. LOUIS, MO.

An Individual Vacuum Cleaner

THE Hotpoint Electric Heating Company, of Ontario, California, is producing a strictly up-to-date vacuum cleaner that boasts of several distinctive features and improvements over those at present on the market.

The Hotpoint vacuum cleaner has an aircooled motor which insures against lubricating troubles; its suction shoe is at least an inch wider than others of its price. Other more or less important improvements have been embodied in the cleaner; it is made of aluminum and nickeled steel which makes it very light in weight (weighs only 9 lbs.) has pistol grip handle, rubber tired wheels; locking device on handle so that it will remain in upright position; push button control in handle; adjustable rear roller to keep nozzle at proper distance from nap of carpet. It operates from a lampsocket on either alternating or direct current and consumes from 200 to 240 watts. Retails at $27.50.

To further increase the utility of this new Hotpoint seven attachments are provided for at an additional cost of $7.50. They consist of nickel plated tube; hose; attachment for cleaning radiators, in cracks, etc.; blowing attachment; connection between hose and cleaner; brush for cleaning clothes and nozzle tool for cleaning walls, curtains, etc.

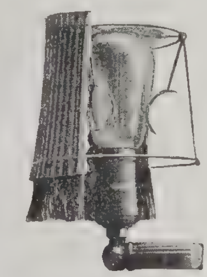
Silk Shades

IN VIEW of the growing appreciation on the part of the consumer for softened and colored light, unusual interest is attached to recent developments made in the manufacture of silk shades in various colors which meet the requirements of electric

lighting. The objections urged against so many shades on the market, have been done away with, apparently, by the Storrs Mica Co., Owego, N. Y., in their latest productions.

These shades fit all standard incandescent electric lamps, from the 10 to 60 watt sizes. Special holders are not required. The shade is slipped over the lamp bulb and three positive spring wire grips, in contact at six points on the sides of the bulb, hold the shade firmly in place. The centering mica disc securely fastened in the top of the shade rests on top of the lamp bulb when the lamp is in an upright position.

With lamps in a pendant position this mica disc fits closely around the neck of the bulb, and as mica is a non-conductor of electricity, the claim is made that it is not possible for the wire frame on Storrs' shades to become grounded or cause a short circuit, as so frequently happens with poorly designed wire frames.



Silk Shades for Electric Lamps—Storrs Mica Co., Owego, N. Y.

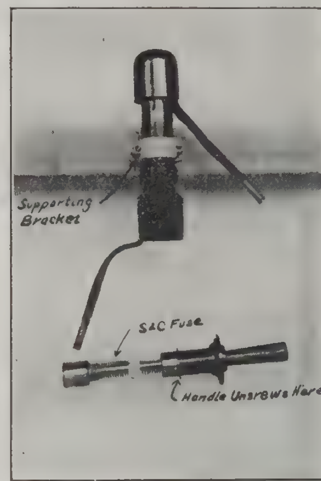
Storrs' silk shades produce the proper diffusion of light by a special process treatment on its inner surface with a mica flour—minute particles of ground mica—mixed with a suitable binding fluid deposited on that part of the silk forming the inside of the shade.

Another innovation is the circular silk disc of the same material as the shade, fastened in the top of these shades, for upright use, so as to cast a tinted light on wall or ceiling.

The frames for electric lamps are furnished without silk coverings where it is desired to use a particular fabric to match other material or for any other reason desired.

Pole Type Cut-Out

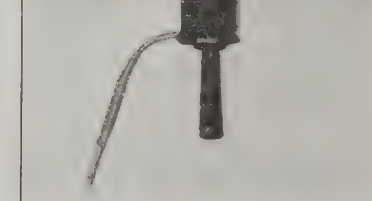
TO MEET the demand for a type of cut-out for the protection of large distributing transformers of high capacity lines which will give unfailing protection under all conditions without destroying itself, brought about the designing of a new pole type cut-out as illustrated herewith. It is manufactured by Schweitzer & Conrad, Inc., of Chicago, Ill. This device is practically an adaptation of their well-known high potential fuse which has a long positive break with a large rupturing capacity and will open short-circuits with unlimited capacity behind them, with absolute reliability. The live parts of the cut-out are well protected and it is therefore perfectly safe to handle at all times. The fuse is locked in place before the circuit is closed, and gasses freed when the fuse operates on short-circuit are directed upward and away from the operator through a vent in the top instead of downward as is usually the case. A positive indication of the condition of the fuse can be obtained without disturbing the cut-out which helps to simplify the location of trouble. This type of cut-out is made in various sizes, but the one here illustrated has a rating of 200 amperes at 4,400 volts. This cut out is also applicable to the protection of circuits and for sectionalizing and isolating branch lines in time of trouble; for the protection of underground services fed from overhead networks; as a fuse or disconnect in substations.



S. & C. Pole Type Cut-Out, Fuse Ready to be Inserted

A Compact Washer

AN ENTIRELY new principle in washers is represented by the Baby Geyser electric washer placed on the market by the Capital Electric Company of Chicago, Ill. This machine is only 14-in wide and is designed to be located in the bathroom. It has a capacity of three sheets of seven shirts in one washerfull, which may be turned out in twelve minutes. The washing is accomplished by a powerful stream of hot suds being forced through the clothes instead of lifting the clothes in and out of quiet water. As shown in the illustration, the hot water may be run directly into the washer by means of a bathroom hose, and the dirty water may be drained into the bowl. It is operated by a small motor, having two blade propellers mounted on its shaft, which is the only moving mechanism. The cylinder containing the clothes is revolved by the force of the water from the propellers, thus belts, chains and gears are done away with.



Cut-Out Installed on Cross Arm—Schweitzer and Conrad, Berteau and Ravenswood Ave., Chicago, Ill.

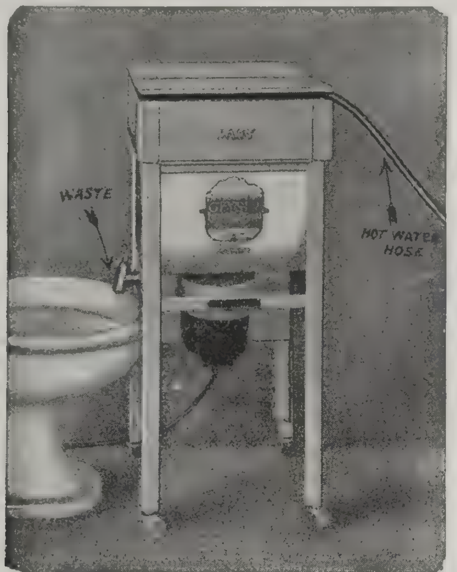
Jacks for Pole Removal

WITH pole-line systems it is sometimes necessary to move poles from one location to another, or to take them out entirely. The removal of any pole is by no means an easy job, as it requires considerable time, in addition to a number of men.

The Simplex pole jack, as made by Templeton, Kenly and Co., Ltd., of Chicago, Ill., has been especially designed for the pur-

pose of removing poles. It supersedes in effort, time and expense, all former means of pulling a pole, and eliminates the necessity of digging around the pole.

In the photograph shown, the pole was about five feet in the ground, had a big butt, and had been embedded solid for years. It took just 19 minutes for the Simplex to pull it straight from



Small "Geyser" Washer—Capital Electric Co., 321 North Sheldon St., Chicago, Ill.

the earth—with no preliminary digging around the pole. The time necessary by former methods of digging first, and operating with roller and rope, would have approximated an hour and a half; hence as a labor saving device the tool should quickly pay for itself.

This pole jack, identified as No. 318, is single acting, operating

Removing a Pole With a Simplex Jack.—Templeton, Kenley & Co., Ltd., 1020 South Central Ave., Chicago, Ill.

on the down stroke of the lever, or tripping at any point. In this way at the end of its entire lift, the cap may be dropped back to take a new hold on the pole. The capacity is 15 tons, lift 24-in. and height 39-in. It pivots on its own base from 30 to 90 degrees to the horizontal, and follows the angle of the pole being pulled.

The cap is recessed to firmly hold the links of the chain when they are dropped in position. The chain with grab hook attached, furnished with the jack, is of sufficient length to wrap once around the average pole. An I-beam base support acts as a substantial foundation where the ground is soft or hallowed. The standard is a heavy malleable casting. All other parts are drop forgings. The double lever socket insures a convenient position for the lever bar with the jack at any angle. A five-foot steel lever bar of pinch bar design also forms part of the equipment.

Trade Literature

A Complete Review of the Latest Catalogs and Books

The Lighting Handbook is a practical treatise covering the general subject of illuminating engineering. A complimentary copy may be secured by addressing the Holophane Works, Cleveland, Ohio. This booklet is written from the practical standpoint and contains technical as well as installation and performance data on the products which are made by the manufacturers.

Standard Show Window Reflectors is the name of a catalog recently issued by the National X-Ray Reflector Company, of Chicago, Ill. It describes the use of their various reflectors for correct store and showcase lighting and shows many illustrations of actual installations. Data to enable one to make a proper selection to suit any condition is also included. For a free copy of this catalog write to the manufacturers.

New A. C. and D. C. portable measuring instruments are treated in the bulletins received from the Weston Electrical Instrument Company, Newark, N. J. Bulletin 2004 describes the new voltmeters; bulletin 2003 deals with ammeters and bulletin 2002 covers the new line of portable wattmeters. Copies of the above will be sent gratis by the manufacturers upon request.

Lighting Hints for the Manufacturer and the New Lamp for the Home, are the titles of leaflets just received from the National Lamp Works, Nela Park, Cleveland, Ohio. These describe their new high-efficiency Mazda lamps.

Motor-driven flexible shafting for drilling, grinding buffing, screw driver, etc., is the subject of Bulletin No. 54 issued by the Stow Manufacturing Co., Binghamton, N. Y.

Getting it Down to a Fine Point is the name of a leaflet describing the portable grinders made by Wisconsin Electric Company, Racine, Wis. Other leaflets received, describe their Universal motors and the Dumore sewing machine motor.

Catalogue Number 10121 issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., is an illustrated booklet showing representative mill installations made by the manufacturers. Copies of this bulletin may be had free by writing to the company.

Hydrometers and hydrometer syringes of the Autocrat type as made by the American Thermo-Ware Company of 16 Warren St., N. Y., are listed and described in a recent bulletin. These instruments are designed for storage battery, automobile and other uses.

Lighting That Makes the Home Attractive is a neat and interesting booklet on home lighting. It is illustrated with photographs of actual installations, each of which represents one definite feature in the illumination of the homes. Sufficient text matter to describe the illustrations is included. Copies of thie pamphlet may be had without charge by addressing the Westinghouse Lamp Company, 1261 Broadway, N. Y.

Several leaflets just received from the Enameled Metals Company, of Pittsburgh, Pa., describe and list the Pittsburgh Standard enameled and galvanized rigid conduits. These conduits have a thread protection which saves the pipe from possible injury during shipment; the protection when removed on the job, leaves the threads clean and sharp.

Controllers for Steel Mill and crane service of the Type C as made by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., are described and illustrated in leaflets just issued.

Electrical Blasting Supplies are listed in the bulletins of the E. I. DuPont DeNemours Powder Co., Wilmington, Del. Caps, igniters, and pocket blasting machines are described.

Bulletin No. 25 entitled Street Series Alternating-Current Incandescent Lamp Circuits, dealing with important factors in the design and operation of incandescent series systems. This bulletin contains a mass of information on the means of securing the highest degree of satisfaction in the use of series lamps. Bulletin 13E, on Multiple Mazda Lamps, is now available. This is devoted largely to a discussion of the characteristics of multiple lamps; engineering data on mazda B, C, and B-coil lamps are included. Bulletin 20, on Industrial Lighting, is a 64-page bulletin published in October, 1913. It is supplemented by a 4-page folder which supplies new tables for the convenient calculation of operating costs, the latest data on lamps, and data on a typical mazda C industrial installation. Copies of these papers may be had by application to the Engineering Department of National Lamp Works, Nela Park, Cleveland, Ohio.

Rules and Information is the name of a new handbook issued by the Commonwealth Edison Company. It relates to their service and contains information on the installation of service-constructions, meters, motors and other electrical appliances which may be connected to their system. It is concise and replete with information.

Examples in Alternating Currents is the title of a book which tells just what you need to know regarding the solution of a.c. problems. It is published by the author, Prof. F. E. Austin, Box 441, Hanover, N. H.

Steam Boiler Economy by William Kent, M. E., Sc. D., author of the Mechanical Engineers' Pocket-book, has recently been revised and enlarged, appearing in the form of a second edition. It is absolutely up-to-date and treats exhaustively on the theory and practice of fuel economy in the operation of steam boilers. It is replete with practical engineering data and is thoroughly illustrated. Some of the features covered include boiler design and construction, boiler room appliances, the chemistry of fuel and combustion, tests of the heating value of coals, methods of firing, smoke prevention, boiler economy and capacity, etc. This work should be in the hands of all engineers and operators of electric plants using steam boilers. Size 6 x 9, 458 pages, 126 illustrations, price $4.50, published by John Wiley and Sons, 432 Fourth Ave., New York.

The Experience Grading and Rating Schedule by E. G. Richards, is a 104-page book which presents a plan for insurance rate-making based on an actual extensive underwriting experience. The schedules embodied have received the consideration of the Actuarial Bureau Committee for more than a year and as the plan outlined has now been well developed, the printing of the book has been authorized. It is published by the National Board of Fire Underwriters, New York.

Principles of Direct Current Machines by Alexander S. Langsdorf, M.M.E., is the first of a series of electrical engineering texts to be published by the McGraw-Hill Book Co., 239 West 39th St., New York. The book is intended for students of electrical engineering and should also prove of considerable value to the designer of electrical machinery. Higher mathematics is used extensively to illustrate the various points dealt with but the compositions are generally preceded by explanatory text matter discussing the particular problem under discussion. Some of the features in this book are the general laws and definitions, armature windings, operating characteristics of generators, commutation, efficiency rating and heating. Size 5x8, over 308 illustrations, price $3.00.

Motor Application.—A contemporary journal recently listed 175 different uses for small electric motors from one-third to one horse power.

Personals

D. S. Miller, formerly with the New York, New Haven & Hartford R. R. Co. as supervisor of power and lines, has been appointed manager of power and lines of the Reading Transit & Light Co., and its affiliated companies, with office in Reading, Pa.

F. W. Hild, for nearly five years past general manager of the Portland (Ore)., R'way., Light & Power Co., has accepted the position of vice-president and general manager of the Denver Tramway System, Denver, Colo.

T. Lee Miller has been placed in charge of the Sangamo Electric Company's New York office, 50 Church St. He is a graduate mechanical engineer, and for the past four and a half years was associated with the Toledo Railways & Light Company in the capacity of assistant to the president and in charge of purchases and car maintenance.

Samuel Kahn, general manager of the Western States Gas & Electric Company, has been elected a director of the Pacific Coast Gas Association.

John C. Parker has resigned as head of the engineering department of the Rochester Railway and Light Company, Rochester, N. Y., to accept the chair of Electrical Engineering at the University of Michigan in Ann Arbor.

The moving picture industry would hardly be the success it is to-day without the aid of electricity. Electric arc lamps are used to project the picture from the film to the screen. Electricity is also used in the manufacture of the films.

One of the greatest handicaps in the industry was the delay in converting exposed films into finished pictures, caused by inadequate facilities for drying the negatives. The films, as soon as they are developed, fixed and washed, are wound on huge drums which are rotated rapidly in electrically heated air. Each drum, which is about 27 ft. in circumference, is driven by a 1-h. p. motor so that the air in contact with the wet emulsion is constantly changed. One 3000-watt air heater is set back of each drum. Before the heaters were employed it usually required from seven to ten hours to dry a reel of film, and never less than four hours, depending on the humidity of the atmosphere. Now films can be dried in about one-quarter of the time formerly required. Another advantage which has been obtained from rapid drying is that the films, by not being allowed to become soggy with moisture, are turned out tough and durable.

The telephone line from New York to San Francisco is overhead throughout its entire extent except for a few short stretches of cable in cities and under rivers. Notwithstanding the improvements which have been made in underground cables, it is still necessary in such long lines as this to exclude as far as practicable all lengths of cable, however short. Even with the very best cable and apparatus known to the art, the distance through which speech may be clearly and distinctively transmitted is greatly restricted when the wires are placed underground.

Current Consumption.—Last year, according to the census taker, the total output of the 5521 central electric stations in this country was 14,000,000,000 kilowatt-hours of current.

We are advised by the General Vehicle Company that an error was made in their advertisement appearing on page 17 of this issue of Electrical Age, the last paragraph should read:

"With nearly 5,000 G. V. Electrics in daily operation we offer you six models representing by far the most substantial progress in Electric road transportation, etc."

Review of the Month

A Complete Record of Important News Edited for Busy Readers

A meeting of the Wiring Committee of the Commercial Section of the National Electric Light Association was held on September 17th, at the headquarters in New York City.

The standardization of plugs and receptacles was treated in a report by representatives of manufacturers.

On the question of bare concentrice wire, several members reported on installations already made in their cities, using standard American fittings, and Mr. Sargent, of the General Electric Company, reported that in accordance with the request of the committee, the General Electric Company was going ahead with the preparation of special fittings and possibly a few special tools and hoped to have these ready by the middle of November. It is the opinion of the committee that as soon as these fittings are ready, a very large number of additional installations will be made with the permission and for the information of the Underwriters and other inspectors.

On the question of the Solid Neutral, it was reported that the Sprague Company are getting out a bulletin showing panel boards designed for the use of solid neutrals without fuses or switches on the grounded wires, either the grounded neutral or the grounded side of the two-wire cirruits, which would result in a very distinct reduction in the cost of large installations as well as being in accordance with the new safety rules.

It was recommended that the various members of the committee take steps in their various cities to have this principle recognized and approved by the local inspectors.

Circular 54 of the Bureau of Standards had been referred to the committee by the National Electric Light Association for report and a number of recommendations in regard to the same were drawn up which will be submitted to the representatives of the National Electric Light Association who are to appear before the Bureau of Standards at the conference.

It was decided to hold the next meeting of the committee in Schenectady some time in November when the new fittings of the General Electric Company would be ready.

The Bureau of Standards announces the postponement of the conference that was to meet at Washington on October 27 and 28, 1915 until a date to be announced later. This sudden change of plans is due to the urgent request of the National Electric Light Association, the American Institute of Electrical Engineers, and the Association of Edison Illuminating Companies that additional time be granted for the consideration of the code of rules that has been formulated by the Bureau before they are submitted to a formal conference.

At the last meeting of the American Society of Mechanical Engineers, the committee on Standardization of Special Threads for Fixtures and Fittings, presented a report dealing with rolled threads for screw shells of electric sockets and lamp bases. It is recommended that the standards presented be known as the American standards. E. S. Sanderson, is chairman of the committee.

The Electric Vehicle Association of America held its sixth annual convention at Cleveland during October 18 and 19. The attendance was large and a banquet in Hotel Statler ballroom closed the convention. One of the points considered was the affiliation of this organzation as a bedy with the National Electric Light Association, the question going over for the next meeting of the executive committee. Among the many interesting papers read at the various sessions were the following: The Electric Taxicab, by A. S. Schrimger; Electrical Vehicles in Municipal Service, by A. J. Slade and R. Duval Dumont; the Function of the Electric Garage, by R. Macrae; Data on the Hartford Electric Light Company's Experience with the Battery Exchange System for Commercial Vehicles, by W. M. Thayer; Comparative Development of the Commercial-Power and Electric Vehicle Loads, by H. H. Holding and S. G. Thompson; Industrial Trucks in the Service of the Pennsylvania Railroad, by T. V. Buckwalter; The Small Electric Vehicle and Its Application, by C. A. Ward, and the Comparative Performance of Gasoline and Electric Vehicles in Similar Service, by W. J. Miller and S. G. Thompson.

Another feature of this convention depicts the most recent achievements of the electric vehicle industry in the form of displays of the most useful and modern products of the art. The following is a list of the exhibitors and their exhibits: The American Taximeter Company displayed mileage recording devices; Baker R. & L. Company exhibited an electric brougham; Cutler-Hammer Manufacturing Company demonstrated their battery charging devices; Electric Storage Battery Company showed their products; Elwell Parker Electric Company has one of their industrial trucks on view; General Eletcric Company exhibited battery charging, devices, motors and controllers; Gould Storage Battery Company exhibited their storage batteries; Lincoln Electric Company dsplayed their battery chargers; Philadelphia Storage Battery Company, U. S. Light and Heating Company and the Willard Storage Battery Company displayed their respective types of storage batteries; Ohio Electric Car Company had on view one of their electric broughams; Leonard-Bundy Electric Company exhibited a line of rheostats; National Carbon Company displayed their line of carbon brushes, while the Hertner Electric and Manufacturing Company demonstrated their battery charging devices.

The following were elected as new officers of the Electric Vehicle Association of America:—W. H. Johnson, president; E. S. Mansfield, vice-president; W. H. Blood, Jr., G. H. Kelly, P. D. Wagoner nd J. F. Gilchrist, directors. H. M. Edwards and A. J. Marshall were re-elected as treasurer and secretary respectively.

The thirty-fourth annual convention of the American Electric Railway Association and its allied and affiliated bodies was held at San Francisco during October 4 to 8. Among the many interesting papers may be named the following: Foundation Principles of Utility Valuation, with Special Application to Resettlement Plans, by B. J. Arnold; Report of the Committee on Power Generation, J W. Welsh, chairman; The Value of Statistics to Executives and Accounting Heads, by Geo. B. Willcutt; Report of the Joint Committee on Engineering Accounting, F. H. Sillick and C. R. Harte, co-chairman; report of the Joint Committee on Block Signals for Electric Railways, J. M. Waldron, chairman. These papers will be abstracted in a future issue of Electrical Age.

Regarding the annual meeting of the Southeastern Section of the N. E. L. A., the details of which were announced in earlier issues of Electrical Age, it has been learned that the following officers were elected: President, J. C. Woodsome, Tampa, (Fla.) Electric Company; first vice-president, J. H. Plummer, Ashville, (N. C.) Power and Light Company; second vice-president, H. A. Orr, Southern Public Utilities Company, Anderson, S. C. The members of the executive committee include J. W. Lindsey, Durham, (N. C.) Traction Company; A. Wallace, Columbia, (S. C.) Light and Power Company; C. I. Day, Southern Utilities Company, Jacksonville, Fla.; C. D. Flanigan, Athens, (Ga.) Railway and Electric Company, and W. E. Mitchell, Alabama Power Company, Birmingham, Ala.

The thirteenth Jovian convention was held in Chicago during October 13, 14 and 15. The program included extensive entertainments among which was the Feast of Jupiter. Among the technical features of the program were papers on the following subjects: Extending the Utilization of Electrical Energy; The Relation of the Jobber to the Electrical Industry; Safety in Electrical Installations; The Progress of the Electrical Industry, and the Public Utility as a Factor in the Development of a City.

Among the new elections are the following: Thomas A. Wynne, Jupiter; E. C. Bennett, Mercury. Directors for the various districts were also installed.

The Western New England Section of the National Association of Electrical Inspectors, held a meeting on October 13 in Greenfield, Mass. A. H. Hopkins, vice-president, presided in the business session and an interesting paper was read by F. L. Hunt, consulting engineer of the Turners Falls Power & Electric Company on "Outdoor Station Development and Equipment."

The eighth annual meeting of the Northwest Electric Light & Power Association held last month, at Portland, Ore., was very well attended. A strong plea was made that legislation be adopted that would enable capital to finance neglected water power in the Northwest, and resolutions were adopted calling the attention to the unlimited water supply and restrictive legislation that prevents development of this supply.

The following officers were elected at the recent convention of the New England Section of the N. E. L. A.: W. S. Wyman, president; R. W. Rollins, vice-president; Bowen Tufts, treasurer; A. H. Ford, Ralph D. Smith, Walter H. Vorce, C. R. Hayes, A. B. Lisle, and George B. Leland, executive committee.

At a recent meeting of the Buffalo General Electric Company Section of the N. E. L. A., Adam Gunn was elected president, Edward C. Cursons, vice-president; Roscoe McMillan, corresponding and recording secretary; Frank E. Bowes, financial secretary; William C. Bingham, treasurer. Executive committee, William R. Huntley, Robert M. Emblidge, Earle A. LeFever and August C. Smith.

American Institute of Electrical Engineers held its first meeting of the 1915-16 season in Pittsburgh late last month. The program included a dinner, after which a paper on "Outdoor Sub-Stations" was presented by B. W. Kerr, manager of the Railway and Industrial Engineering Company. The evening was concluded with a discussion of the paper by prominent engineers.

The New York Section of the Illuminating Engineering Society held its last meeting on October 14. Lieut. C. McDowell, of the Brooklyn Navy Yard, and Capt. E. Ardery, Corps of Engineers, U. S. Army, addressed the meeting on the subject of "Illumination in the Army and Navy."

Preferring to announce the accomplishment rather than the promise of a great achievement, the American Telephone and Telegraph Company startled the world, on September 29, by proclaiming that wireless messages had been sent across the continent, and within less than twenty-four hours, made still more remarkable records in long distance wireless telephony.

At 12:48 o'clock P. M. Eastern time, Theodore N. Vail, president of the A. T. and T., sitting in the company's offices at 15 Dey street, New York, spoke into a Bell telephone connected by wires of the Bell system with the radio station at Arlington, Va., and his words leaped through the ether from that tower to Mare Island, Cal., where they were caught by the antennae of the radio station there and heard by John J. Carty, chief engineer of the A. T. and T. Other conversations were also held.

The Bell wireless system is not yet fully installed at Mare Island, San Diego, Darien or Pearl Harbor, the receiving apparatus only being in position at these stations, hence it was impossible for messages to be telephoned back by wireless, but all the messages sent from or by way of the Arlington tower were recorded at the respective receiving stations and their receipt fully confirmed by the officials in their reports by wire. The demonstrations were held by permission of the Navy authorities at the various stations and the experiments were witnessed and verified by them.

The distance covered in the experiments are as follows: Arlington to Mare Island, 2,500 miles; to San Diego, 2,300 miles; to Darien, 2,100 miles; to Honolulu, 4,900 miles, the latter being greater than the distance to London, Paris, Berlin, Vienna or Petrograd. The results obtained are the culmination of a long and important series of investigations and discoveries extending over a considerable period.

The General Electric Company's plant at Schenectady, N. Y., was tied up by a strike on October 4th, when 13,000 of the workers left their benches and machines, demanding an eight-hour working day and a twenty per cent. increase in wages.

It is said that efforts are being made by the representatives of the trade unions to spread the fight for an eight hour day into every plant of the General Electric Company.

An offer of nine and one-half hours, with a 5 per cent. increase in wages, made by the company, was voted down by the strikers 10 to 1 on October 18. On learning the result of the vote, General Manager Emmons declared that all men who remained away after Wednesday, October 20, would have to seek re-employment and that the company would cease to recognize grievance committees.

The Usona Manufacturing Co., Inc., makers of Kwik-Lite products, announce the opening of a new branch office and warehouse, in the Wells-Fargo Building, San Francisco, Cal. Other offices are at Memphis, Toledo and Winser, Can.

The Westinghouse Lamp Co. announces that, owing to increase of business, it has been found advisable to open its Milwaukee plant. About 500 additional workers will be employed. Frank Wicks, formerly superintendent of the New York plant, will be in charge.

The Crown Williamette Paper Co., of Portland, Ore., will shortly increase the capacity of its electric generating station by the installation of a 1250 kilowatt water-wheel type alternating. This machine will operate in parallel with two smaller machines at present installed, and is being supplied by the Westinghouse Electric & Mfg. Company.

In order to encourage the spirit of thrift among its employes of the Westinghouse Electric and Manufacturing Company has just established a savings fund which offers facilities to the employes for the handling of their savings accounts. The amount of the deposit cannot be less than 10 cents and may be any

multiple thereof and the deposits must be made from each regular pay. The deposit, however, is limited to to one account, the amount of which in any one year cannot exceed $500. Interest is paid on the deposit at the rate of 4½ per cent. and is credited semi-annually. The Westinghouse Company acts as a trustee and guarantees the deposits and interest.

The Monarch Refillable Fuse Company is erecting a new factory on Leslie Avenue, Buffalo, N. Y. This plant will greatly increase the company's manufacturing capacity.

The Fargo Manufacturing Company, which makes the F. M. C. Line of electrical and mechanical connecting devices, has opened a general sales office in charge of Alvin S. France, at 52 Vanderbilt Ave., New York City.

The Syracuse Lighting Co. is to erect a $500,000 sub-station at Syracuse, N. Y., to handle the distribution of more Niagara and Salmon River power in that city.

The Lykens Valley Light & Power Co., a new corporation, composed of Philadelphia and Baltimore capitalists, has purchased the plant of the Sterling Consolidated Electric Light, Heat & Power Co., of Tower City, Pa.

Contracts for electrical equipment aggregating $140,000 have been awarded by the Youngstown Sheet & Tube Co., to the General Electric Co.

The North Branch Transit Company, which operates an electric road out of Bloomsburg, Pa., has been placed in the hands of a receiver upon a petition of the Columbia and Montour Electric Company, A. W. Duy being the appointee.

Slowly but surely, the Wisconsin Gas and Electric Company is buying up the various independent plants in Wisconsin, the most recent purchased being the plant and equipment of the Burlington Electric Light and Power Company.

A reduction of approximately 10 percent in the price of electricity to the consumers of the city of Birmingham, Ala., has been agreed to by the Birmingham Railway, Light and Power Company. This brings the rate down to practically 8 cents per kilowatt-hour even to the smallest consumer.

Long Island Lighting Company, announces a reduction in rates both for light and power for the district carried by its Huntington, L. I. plant. The power rates are reduced to 10 cents per kilowatt hour to small consumers and run as low as 3 cents to users of large quantities. The rates for lights start at 14 cents and run as low as 10 cents per kilowatt hour.

A valuation of $8,451,000 has been fixed upon the property of the Union Gas & electric Co., Cincinnati, Ohio, by the Ohio Public Utilities Commission, and this will form the bases for the new electric light rate for Cincinnati. The commission has previously had the company's side of the case, in which a valuation of about $21,000,000 was placed upon the property, as against $7,800,000 by Cincinnati's expert. The estimate fixed by the commission was $8,451,000.

The Kansas Gas & Electric Co., has filed an application with the Kansas Public Utilities Commission asking that it be permitted to issue $200,000 worth of preferred stock, and bonds in the amount of $325,000.

The official report of the income account for August, of the Pacific Light and Power Corporation shows a gain in gross earnings of 11½ percent and a gain in net earnings of 15.66 percent over the same period last year.

The report of the Mississippi River Power Company for the year ending Aug. 31, 1915, shows a gross income of $1,625,671; net earnings were $1,280,731 and the surplus, after interest charges, etc., was $61,186.

The Lowellville, Ohio, power station of the Mahoning and Shenango Railway and Light Company will be doubled in capacity by the new $750,000 power plant which is now being constructed. The present station capacity is 20,000 horse-power.

Cedar Valley Electric Company has received a 25-year franchise from the town of Nashua, Ia., and has purchased a power site for $35,000.

During the hearing held by the St. Louis, Mo., Board of Aldermen investigating into the feasibility of a municipally owned light plant, it was brought out that the North American Company would rather sell the Union Electric Light and Power Company to the city than try to operate in competition with a municipally owned plant.

The Consolidated Electric Co., with an issue of $2,267,500 first mortgage bonds, has been created at San Francisco, Cal., to consolidate the bonds, notes and accounts of the following corporations: United Light and Power Company of California, United Light and Power Company of New Jersey, South Side Light and Power Company, Consumers' Light and Power Company, Central Oakland Light and Power Company, Equitable Light and Power Company.

Towns in Northern New York are assured an improved service through the efforts of the Empire Gas and Electric Company, Central New York Gas and Electric Company, and Empire Coke Company. About $161,200 will be expanded for improvements in Auburn, Geneva and vicinity. The cost will be taken care of by an issue of securities recently authorized by the up-state Public Service Commission.

The Chatham Electric Light, Heat and Power Company of Chatham, N. Y., has been granted by the Austerlitz, N. Y. town board a franchise to erect poles and string wires in that town and has applied to the Public Service Commission for permission to extend its line to Morehouse Corners, about half way between Chatham and Spencertown.

The Mt. Vernon Light and Power Company, Mt. Vernon, Me., has been granted permission by the Public Utilities Commission to furnish its service to the towns of Mt. Vernon, Vienna and Rome, Me.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF AUGUST 24, 1912, of **Electrical Age**, published monthly at New York, N. Y., for Oct. 1, 1915.

Name of—

Editor, Chas. B. Thompson, Forest Hills, L. I.

Managing Editor, Chas. B. Thompson, Forest Hills, L. I.

Business Manager, Chas. B. Thompson, Forest Hills, L. I.

Publisher, Technical Journal Co., Inc., 233 B'way., New York, N. Y.

Owners: (If a corporation, give its name and the names and addresses of stockholders holding 1 per cent. or more of total amount of stock. If not a corporation, give names and addresses of individual owners.) Technical Journal Co., Inc., 233 B'way., New York, N. Y.; Chas. B. Thompson, Forest Hills, L. I.; Wm. F. Eastman, 72 Columbia Heights, New York, N. Y.; Geo. H. May, Newton Centre, Mass.; Chas. T. Wood, Port Richmond, S. I., New York, N. Y.; Simon Levine, 1146 43d St., Brooklyn, N. Y.

Known bondholders, mortgagees, and other security holders, holding 1 per cent. or more of total amount of bonds, mortgages, or other securities: None.

Average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above. (This information is required from daily newspapers only.)

Chas. B. Thompson,
Business Manager.

Sworn to and subscribed before me this 1st day of October, 1915.

Simon Levine,
Notary Public.

(My commission expires March 30, 1916.)

ELECTRICAL AGE

The National Monthly of Electric Practice

Formerly ELECTRICAL ENGINEERING

Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chas. B. Thompson, President **Wm. F. Eastman, Vice Pres.**

SOUTHERN OFFICE, GRANT BLDG., ATLANTA, GA. *CHICAGO OFFICE, 651 MARQUETTE BLDG.*

Telephones: New York, Barclay 7448; Chicago, Central 3792

Volume 47 DECEMBER, 1915 Number 12

CONTENTS

MEMBER

NATIONAL ELECTRIC LIGHT ASSOCIATION

SUBSCRIPTION PRICE—United States and Posessions, Mexico and Cuba $1.00 a year. Canada $1.50 a year. Foreign Countries in Postal Union $2.00.

CAUTION—Do not pay solicitors, unless they present **written authority**, with date, from the publishers to collect money.

NOTICE TO ADVERTISERS—To insure insertion, all copy, cuts, etc., for changes of regular advertisements in **ELECTRICAL AGE** should reach us not later than the 25th OF THE MONTH preceding date of publication; three days earlier if proof is desired. The first advertising forms close promptly on this date.
NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 30th.

MEMBER

THE SOCIETY FOR ELECTRICAL DEVELOPMENT INC. NEW YORK

"DO IT ELECTRICALLY"

Recognized Organ of the Southern Trade. *Member Audit Bureau of Circulation.*

Entered at the New York Post Office as Second-class Mail Matter.

THIS ISSUE 10,500 COPIES—500 MORE THAN LAST MONTH

ELECTRICAL AGE

The National Monthly of Electric Practice

Formerly ELECTRICAL ENGINEERING

Technical Journal Company, Inc., New York

Vol. 47 DECEMBER, 1915 No. 12

The Equipment of a Modern Substation

Considering the Constructional and Control Features of the Columbia Substation

By H. G. Davis

THE OPERATING and control features of the Parr Shoals hydroelectric development having been treated in a previous issue of ELECTRICAL AGE, this article will therefore consider the details of the substation located at Columbia, South Carolina.

This station was designed as the distributing center for all power in Columbia and is so arranged that it becomes the point at which the station at Parr Shoals together with the old city water-power plant and the steam station of the Columbia Railway, Gas and Electric Company tie together.

The building is of brick, having a concrete roof covered with tar paper and gravel; its physical proportions are shown on the accompanying drawings. The floor being of concrete, all conduit for wires or cable together with other piping is buried in it.

The general scheme of the station is to control two incoming 66,000-volt lines from Parr Shoals. These lines feed two banks of 3 single-phase transformers of 2,500 kva capacity, provision being also made for a third bank of 3 transformers. The transformers installed have two secondary windings, one 13,800 volts and the other 3,400 volts. Each bank of transformers is connected to separate overhead 13,800-volt delta and 3,400-volt delta buses which are connected by leads to the station buses. From the station bus, 3,400-volt feeders are taken out on the east side of the building. The 13,800-volt feeders leaving the bus go to a steel frame work on the roof from which they lead out direct to the mills supplied at this voltage. The old water-power station and the steam plant, both connect with the 3,400-volt bus, provision being made to synchronize between the station bus and these tie lines. The 13,800-volt buses are arranged in the southeast end of the station, while the 3,400-volt buses are located in the northeast end. The floor plan of the station shows the location of these buses and the general arrangement of apparatus. Along the east side of the station above the bus structure is a gallery containing the 3,400 and 13,800-volt aluminum lightning arresters and also a battery room, charging set and other auxiliaries.

Main Connections

The double circuit transmission line enters the building through wall bushings, going directly through the choke coils which are mounted on insulators suspended from a special steel framework. This framing is part of the arrangement for supporting the pair of 3 single-pole disconnecting switches, one being used on each side of each high-tension oil switch. After passing through one set of disconnecting switches the line goes through the high-tension oil switch, through another set of disconnecting switches to the high-tension bus.

The high-tension bus is divided into three sections by means of two sets of disconnecting switches as shown in the diagram of the general electrical layout. These bus-disconnecting switches are mounted overhead on special steel supports, as shown on the floor plan. They consist of three insulators for each pole, the top and bottom insulators containing the contact jaws while the middle insulator clamps the switch rod which contains contacts at each end to work into the contact jaws on top and bottom insulators. The middle insulators for each pole are mounted on an I-beam which operates on vertical rods so that the 3 single-pole disconnects operate together from a sprocket wheel. The two sets of 3-pole disconnecting switches used with each 66,000-volt oil switch, are operated together on one movable I-beam holding the middle insulators. A counter-balance weight is used to make the raising or closing of the switch easier. By the use of this type of disconnecting switch considerable floor space has been saved.

The high-tension oil switches each have bushing type transformers to operate the relays on the high-tension switches. The high-tension delta connections for each bank are made directly over the bank and the delta connections between outside leads of the end transformers of the three in delta are made by running copper tubing between leads supported by post type insulators from the roof truss as shown.

The delta connections for the low-tension windings of each bank are made to delta buses supported on special framework from the roof trusses. The delta low-tension buses are connected to the station low-tension buses through the transformer switches. The general location of the bus structures is shown on the plan and the details of same are given in another drawing.

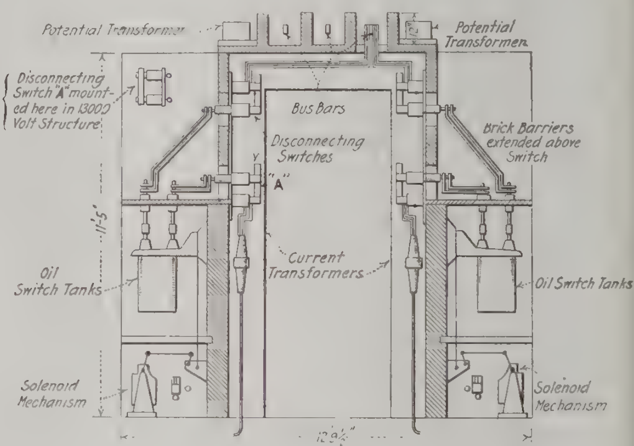
Columbia Substation—View of the 13,000-volt bus structure and oil switch cells.

In the sectional view of the station, the high-tension oil switches are shown with a set of special disconnecting switches on each side of the oil switch. The disconnecting switches on each side of the oil switches are necessary because the transformers all have two secondary windings. In this way the high-tension 66,000-volt circuit may be open but the transformers, if receiving power from the steam station or city water-power station at 3,400 volts and delivering 13,800 volts to the other feeders, would have the high-tension terminals alive. Thus, in order to work on the oil switches, disconnecting switches are required between the transformers and the oil switches. The low-tension switches, except the station feeder-circuit, also have disconnecting switches on each side of the oil switches

A 6-in. iron pipe is provided for the various leads so that they may be taken from the delta buses to the station buses. The three 3,400-volt leads are run in one pipe and the 13,800-volt leads in another pipe to the bus structure. All electrical cables are run in conduit in the floor except the lighting leads and the high-tension 66,000-volt leads. The leads from the delta low-tension buses are run in the iron pipe to the floor, one pipe for each voltage; then they run in 3-in. fibre conduit, each cable in a separate duct to the bus structure. The ground system is run in fibre conduit while the multi-conductor instrument and control wiring is run in iron conduit. The supply mains to the pumps, charging set and battery are run in $1\frac{1}{4}$-in. iron conduit.

Bus Structures

The general scheme of the bus structures is shown in the photograph and the details in the drawing. The transformer oil switches are mounted on the side of the structure nearest the center of the building, each single pole of the oil switches being in a separate compartment. The cables from the transformers come through the ducts up to the disconnecting switches located in the



Columbia Substation—Section through the 3,400-volt bus structure showing detailed arrangement of equipment. The 13,800-volt structure is similar except for clearances, the location of switch marked "A," and the current transformers for feeders being mounted under the gallery floor.

center of the structure as shown, each in its own compartment. Each oil switch has a disconnecting switch on each side of the oil switch for each lead. The pair of disconnecting switches for each lead are mounted on an iron base in the compartment. One terminal of each disconnecting switch is back-connected as shown, so that connections can be made to the oil switch.

The sketch shows the layout of the 3,400-volt bus structure with the feeders leaving the oil switches and going to the east wall through conduits in the floor. The feeders then go up to the gallery through the choke coils mounted in the gallery and out to the lines. The difference between the 13,800-volt and 3,400-volt structures, except for clearance, is that the disconnecting switches on the line side of the feeder oil switches are mounted above the oil switch and on the wall side of the bus structure.

The 13,800-volt feeders then go under the gallery on insulators, up the side of the wall, through the choke coils and the roof pot-heads to a supporting steel frame-

work on the roof. The bus structures are made of buff-faced brick with concrete slabs and slate slabs for the cells. The general effect of this type of structure is very pleasing. The operating solenoids are set under the cells proper, operating the switches by cranks as shown. The 3,400-volt transformer switches and heavy feeder switches require two solenoids for operation.

Oil Switches

The high tension oil switches are triple-pole single throw 70,000 volt form K-21 automatic oil switches with solenoid operating mechanism. The two line switches are of 300 amp capacity while the three transformer switches are of 150-amp capacity. Each triple-pole switch is provided with two bushing type current transformers to operate the relays used for automatic operation of the switches. The bushing type current transformers have two secondary windings so that the line current transformers can be connected to give a ratio of 30 to 1 or 60 to 1, while the current transformers in the high-tension side of the individual transformer banks, can be connected to give a ratio of 26 to 1 or 13 to 1.

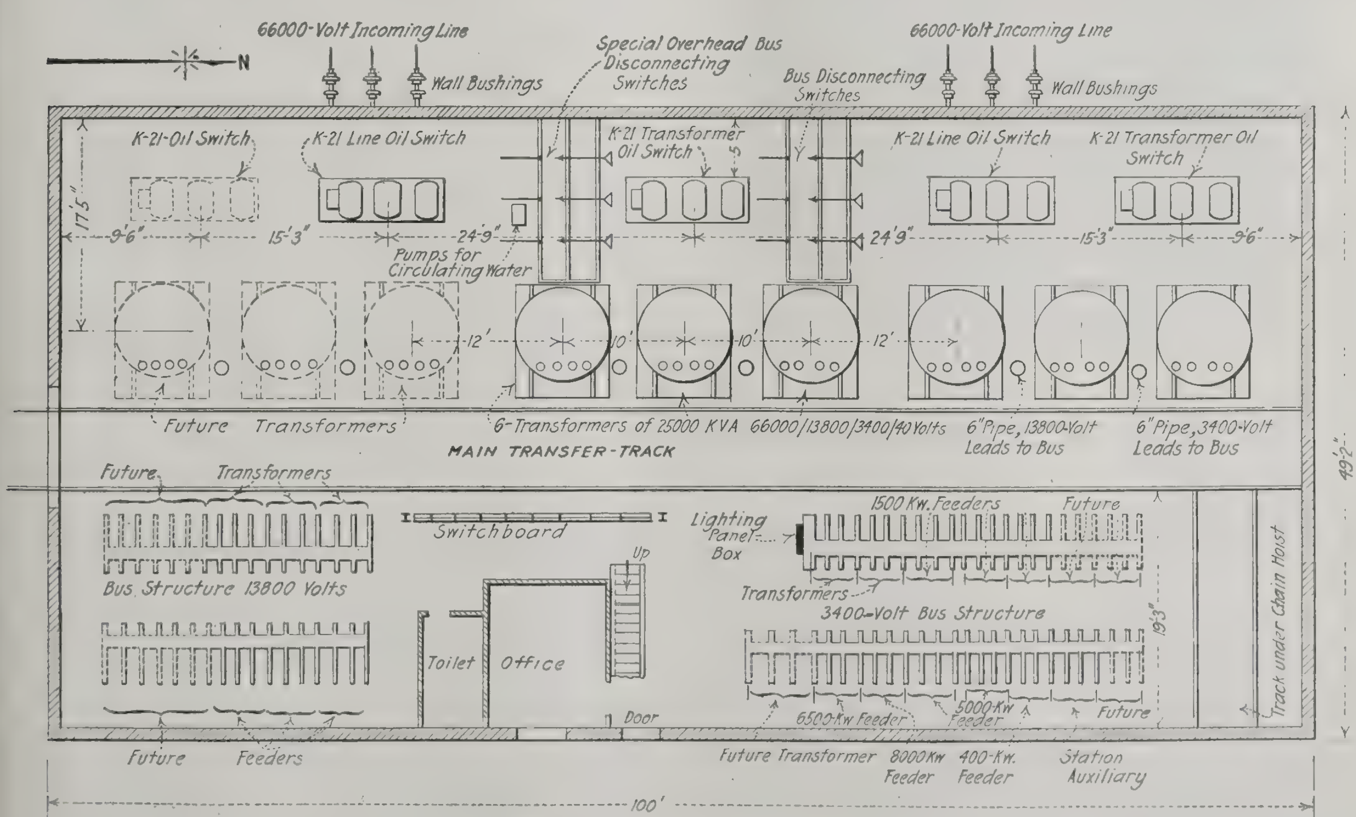
The relays operated from the current transformers have a scale with double calibration to correspond to the double ratio of the current transformers. The relays on the incoming lines are inverse time-limit relays while the high-tension transformer relays are definite time-limit. The bushing type current transformers are used to operate the relays only.

The 13,800-volt switches are all triple-pole single throw automatic, type K-12 consisting of three single-pole elements in cells. The transformer switches are 15,000-volt 500 amp for each bank, while each of the three feeder switches are 15,000-volt, 300 amp. The transformer switches are controlled by double-pole definite time-relays operated from the current transformers while the feeder switches are controlled by double-pole inverse time-limit relays.

The 3,400-volt switches are all triple-pole single throw automatic type K-12 consisting of three single-pole elements in cells. The transformer switches are 4,500-volts 1500 amp capacity for each bank. The feeder switches control circuits of different kva rating and consequently have different current capacity. They have double-pole inverse time-limit relays to operate the switches. The transformer switches are equipped with definite time-limit relays. Thus the transformer banks are protected on each side, high and low-tension, by definite time-limit relays. The current transformers for all relays are of the nearest standard size to the current rating required for the feeders.

Transformers

As previously mentioned, the station transformers are single-phase 2,500 kva, 40 cycle 66,000-volt primary with two secondary windings to give 13,800 volts and 3,400 volts. Tap voltages are provided on the primary to give 63,000/62,000 and 60,000 volts and on one secondary winding to give 13,200 and 12,600 volts. The transformers will give full capacity for each of the tap voltages. Each of the two low-voltage windings is designed for full capacity of 2,500 kva so that when the steam-station is supplying power and the supply from Parr Shoals is cut off, the transformers can be used up to full capacity by receiving power on the 3,400-volt winding and delivering it on the 13,800-volt winding. However, when the power supply to the transformers is on the 66,000-volt winding, the sum of the output of the two low-tension windings must not exceed the rated capacity of the transformer high-tension winding, 2,500

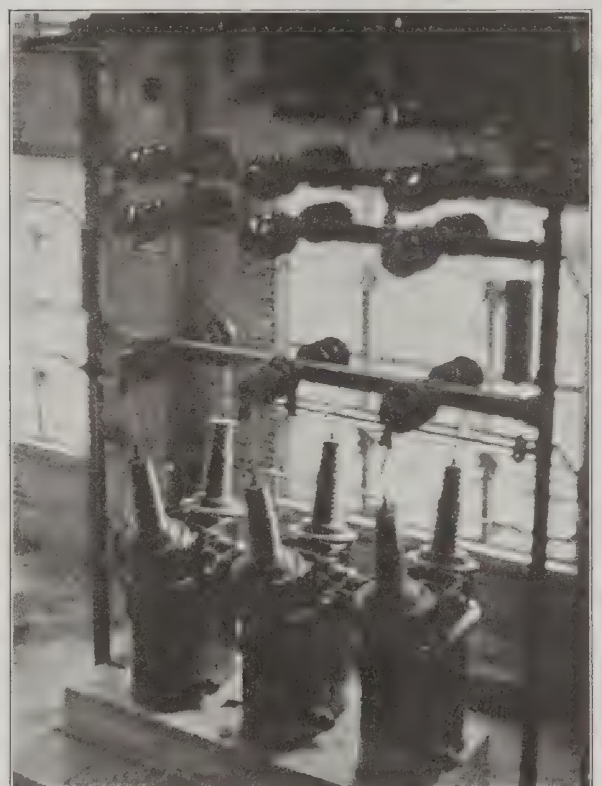


Columbia Substation—Plan of the Station, looking down on main floor; showing the arrangement of the present equipment and the space for future expansion.

kva normal rating, or damage may result to the high-tension winding.

The transformers are guaranteed for a temperature rise at normal rated kva not to exceed 40 deg. C. above the ingoing water since the transformers are of the water cooled type. The water required at normal load is 13 gallons per minute for each transformer. The transformers are also guaranteed for a 25 percent overload for two hours with a temperature rise not to exceed 55 deg. C. with the cooling water increased in proportion to the load or with 16.5 gallons of cooling water per minute circulating through the coils. At full rating and unity power factor the transformer efficiencies are 98.4 percent at 25 percent overload and 97 percent at 25 percent of rating.

The transformers each require about 2,500 gallons of oil and weigh about 60,000 pounds complete, when filled



Columbia Substation—High-tension oil switches and special type of disconnecting switches on steel framework.

with oil. A thermometer alarm to give warning when the transformer temperature has become excessive, is part of the equipment.

Each transformer is mounted on a truck rolling on short tracks at right angles to the main axis of the building. These tracks for the individual transformers are elevated above the floor by concrete piers, all as shown in the sectional view of the station. When necessary, a transformer on a truck may be run out on the main transfer-track at the end of which another short track elevated on piers allows the transformer to be run from the truck until it is under a chain hoist which is used to lift the core from the tank. This is in the northeast corner of the building where the necessary room for the chain hoist is provided by an extension in building height, giving a cupola effect.

Cooling System

To supply cooling water to the transformers, a pumping system is installed. The system takes water from a cooling pond built at the rear of the building. The water is pumped through the cooling coils and back to the cooling pond where it is forced through spray nozzles to obtain the cooling effect. Two pumps are installed, being 5½ by 6 in. triplex plunger pumps of 100 gallons per minute capacity for a discharge head of 80 ft. and a suction lift of 20 ft. These pumps are each geared to a 5 hp, 3 phase, 110 volt, 40 cycle induction motor. Each pump is capable of taking care of the water for all transformers installed.

The suction from the cooling pond is 4 in. and the water enters through a screwed foot-valve with strainer. The supply main to the transformers is of 3 in. pipe while each individual transformer has two 1¼ in. supply pipes and two 1¼ in. returns. Each supply pipe has a sight flow indicator to show when the water supply is working properly. The return from the transformers is of 4 in. pipe. This pipe runs to the center of the cooling pond where it is connected to a cast iron manifold which has three 2 in. galvanized spray arms threaded to receive the bronze turbine spray-nozzles. The nozzles each have a capacity of 33 gallons per minute when operating with a pressure of 5 pounds at the nozzles.

Under this condition it is figured that the water after spraying, even with an air temperature of 90 deg. Fahr. and a relative humidity of 80 percent, will not exceed 85 deg. Fahr. in temperature when the transformers are operated at full load.

The cooling pond is built of concrete and waterproofed. The surface area is 1400 sq. ft. and the depth is 2 ft. 8 in. The amount of water contained is enough so that the total amount will pass through the transformers about once in five hours.

The cooling pond and spraying outfit was resorted to in order to save in the water supply expense. If city water were used there would be a very costly item in operation. The supply from the cooling pond is pumped from a canal which is only about 100 ft. from the substation. The pump for this purpose has a capacity of 10 gallons per minute and the driving motor is connected through a float switch which is controlled by the water level in the cooling pond. Thus the water is pumped from the canal whenever the level of the water in the cooling pond is reduced by evaporation.

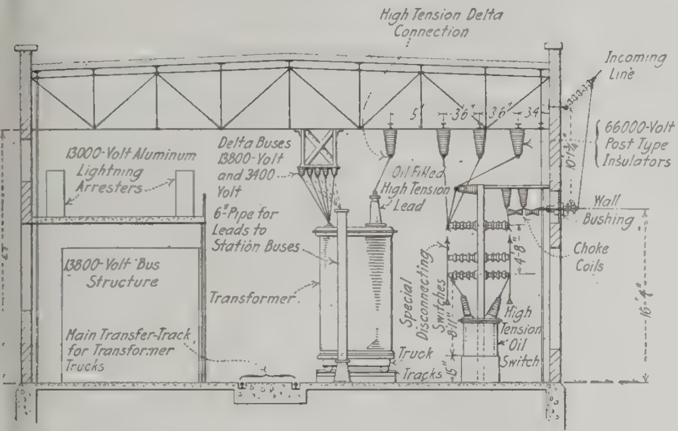
Switchboard Equipment

The controlling switchboard is of natural black slate mounted on 90-in. iron pipe framework. The instruments are all of a dull black finish. There are nine panels with a swinging bracket.

The arrangement of the panels when facing the board and counting from the left is as follows:

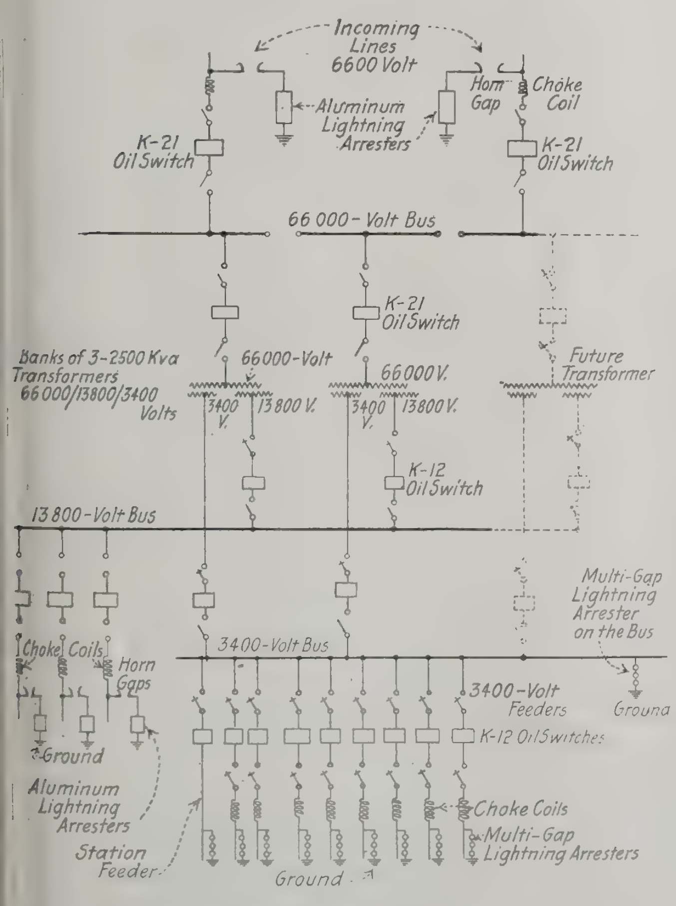
Swinging bracket for synchroscope and voltmeters.
Three 4-circuit 3,400-volt feeder panels.
One battery panel with charging set control.
One incoming-line panel.
Three transformer panels, one for future use.
One, 4-circuit 13,800 volt feeder panel.

The swinging bracket contains 1 synchroscope; 2 voltmeters—one for each low-tension bus—calibrated for 18,000 volts and 4,500 volts respectively; 1 power-factor indicator and 1 d.c. voltmeter. The synchroscope is connected to the synchronizing buses and is used to synchronize between the 3,400-volt bus and the low-tension side of the transformers and between bus and feeder tie lines to the steam-station and city water-power station.

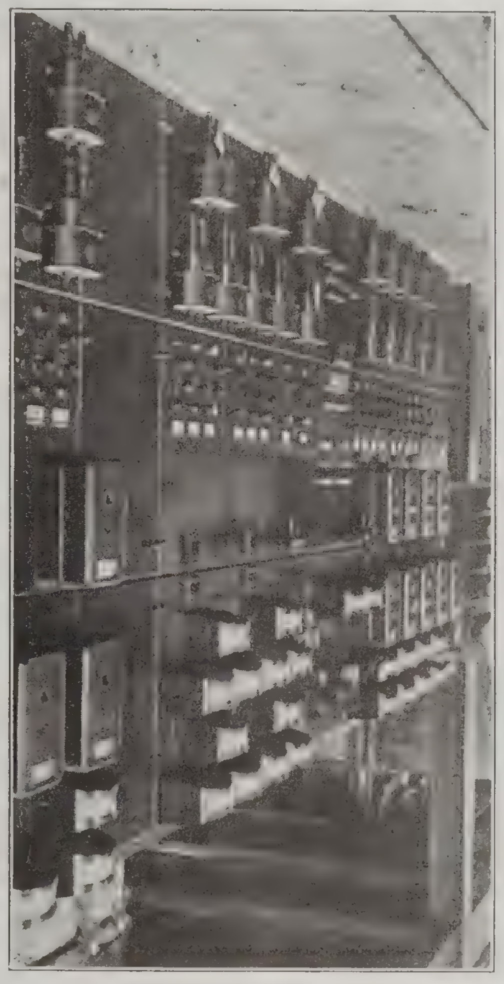


Columbia Substation—Cross section of station showing the location of and connections to, the main equipment.

No synchronizing is done on the 13,800-volt bus. The voltmeter with 18,000-volt scale is connected to a potential receptacle on the incoming-line panel, the receptacle being fed from two potential transformers on the 13,800-volt bus so that all the three phases may be read on this voltage. The voltmeter with 4,500-volt scale is connected to a pair of potential buses which are connected to an 8-point receptacle on the line panel, this receptacle being fed from the two potential transformers on the 3,400-volt bus. A single potential transformer on each 3,400-volt transformer winding and on each feeder tie between substation and city water-power station and steam plant allows the voltage to be read for synchronizing purposes. These single potential transformers also feed to the synchronizing plugs. The single power-factor indicator enables the power-factor on all the feeders to be read by using a turn-button switch, one for each feeder circuit, as it is desired. The d.c. voltmeter on the swinging



Columbia Substation—Single line wiring diagram of the main electrical layout and control features.

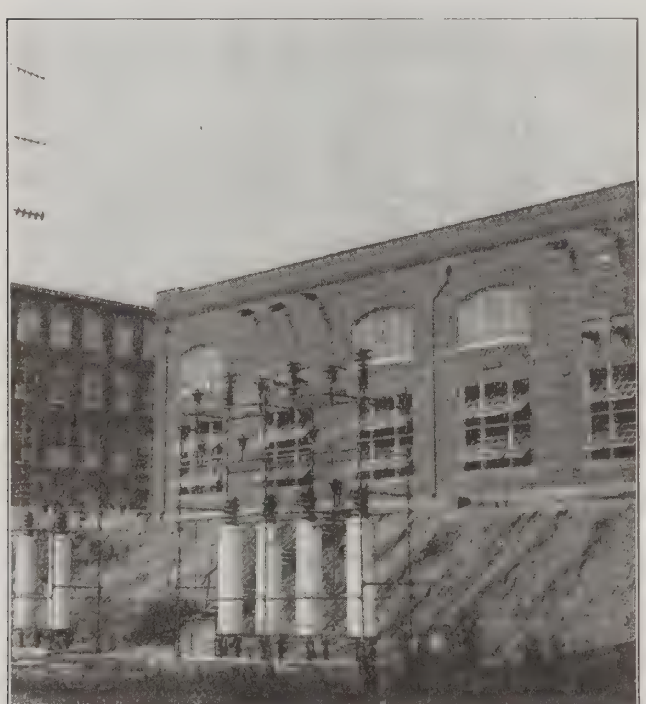


Columbia Substation—Showing the switchboard and its equipment.

bracket is connected to potential plugs on the battery panel and with this the battery voltage and the voltage of the charging generator for the battery can be read.

The three 3,400-volt feeder panels are each laid out for four circuits with a present total installation of nine circuits leaving provisions for three more circuits. Each panel is 24 in. wide. Each feeder circuit is equipped with a polyphase watt-hour meter to read the feeder output and one ammeter to read the current demand of the feeder. Thus each 4-circuit feeder panel contains four watt-hour meters, four ammeters and four inverse time-limit relays, one for each circuit and operated from the same two current transformers that feed the watt-hour meter of the corresponding circuit. The voltage for each 3,400-volt feeder is the bus voltage except in the case of the two feeders which tie in with the city steam-station and the water-power plant. For all other feeders

the potential supply of the watt-hour meters is taken from the bus potential transformers. This bus potential can be read by means of an 8-point receptacle on the incoming-line panel. The two feeders going to the station and city water-power station each have one potential transformer on the line side of the feeder so that the potential can be read for synchronizing. This potential transformer also feeds the potential coil for synchronizing. The panel containing the control and instruments for these two feeders, also contains in addition to the meters as given for the other feeders, the synchronizing plug for each of the two feeders and a 4-point potential plug for each feeder. The feeder oil switch closing-coil for each of these two feeders, is connected through the synchronizing plug. The control switch for the oil switches is of the single-pole double throw pull-button type with red and green indicating lamps. All control switches on the board are of this same type.



Columbia Substation—View of the 66,000-volt lightning arresters outside of building.

The battery panel contains a 3-pole double throw knife switch for the motor of the charging set. This motor is started on full voltage without fuses in the circuit but on the running position, fuses are in the circuit. The necessary switches for charging the battery from the generator using full battery or part battery and also the necessary switches for having the control buses connected to the charging generator, full battery or part battery are also mounted on this board. These switches consist of one triple-pole single throw switch and two single-pole double throw switches. The charging generator circuit contains one 50-amp double-pole circuit breaker equipped with a reverse current and overload coil operating a shunt trip. There are two 60-amp scale ammeters installed to read current. One of these ammeters has a zero center to show direction of current in battery for either charge or discharge. Two 6-point potential receptacles on this panel indicate the voltage of charging set, full battery and part battery, on the bus d.c. voltmeter mounted on the swinging bracket.

The incoming line panel at present controls two circuits, having an ultimate capacity of 22,500 kva at 60,000 volts. This panel is 16 in. wide, and contains the control switches for the two K-21, 70,000-volt oil switches, one in each line. The relays for the two high-tension oil switches operated from the bushing type current transformers are mounted on this panel. These relays are inverse time-limit. This panel also contains two 8-point potential receptacles for reading the bus voltages for each of the 3,400-volt and 13,800-volt buses.

The transformer panels are each of 7,500-kva rated capacity and have the control switches for the two banks of transformers as now installed. One panel is blank for the future bank of transformers. Each panel is 20 in. wide. On each panel are control switches for the 70,000-volt oil switch in the high-tension side, for the 18,000-volt switch between transformer bank and bus, and for the 3,400-volt switch between transformer and bus. There is also installed on this panel, the relays for each of the switches, all transformer relays being definite-time. There are six ammeters on each transformer panel to read the current in each 3,400-volt lead and each 13,800-volt lead from the low-tension side of the transformer. There is also on each panel a 4-point potential receptacle and a 6-point synchronizing receptacle. One single potential transformer is installed on the transformer side of the oil switch of the leads to the 3,400-volt bus for the purpose of synchronizing with the bus in case the bus is already alive and it is also desired to throw in the bank of transformers being supplied from Parr Shoals. The watt output of the transformers is not measured, this being taken at the feeders only. The 3,400-volt transformer switch is the only one used in synchronizing and all synchronizing is done between the 3,400-volt bus and each individual transformer bank or between the bus and the tie feeders to the city station. The closing-coil of the switch used in synchronizing is connected through the synchronizing plug so that there is no danger of closing the switch before putting on the synchronizing plug.

The 13,800-volt panel is 28 in. wide and controls four circuits, each having a capacity of 3,000 kva. three of which are now installed. The panel contains a watt-hour meter, ammeter, inverse time-limit relay for the feeder oil switch and one control switch for each circuit. For each feeder there is also a power-factor indicator transfer switch.

For each watt-hour meter on the switchboard, there is installed on the back of the panel, testing links and calibrating links, so that the watt-hour calibration can be checked without disconnecting any of the meter circuits.

Auxiliary Apparatus

The storage battery as installed consists of 55 cells having a 20 amp 8-hr. rating. This battery operates the oil switches in the station and is also used for the emergency lighting, this being thrown in by the no-voltage release.

Other auxiliary apparatus is operated from the station auxiliary transformers installed in the gallery. These transformers are single-phase with a bank of three connected in delta for the supply of water-pump and air-compressor motors. The transformers are connected to 110-volt buses on pipe frame work and from these buses

the leads to the motors are taken by means of conduit. The switches for individual motors are mounted at the motors except in the case of the motor for the charging set which has the switch mounted at the switchboard.

The 110-volt lighting supply is taken from the low-tension 110-volt buses in the gallery, the leads going direct from the buses to the panel box on the main floor. The individual circuits go direct from the panel box to the lights. All lighting wires are installed in conduit. One cluster of lights in front of the switchboard is connected to the middle point of a double-pole double throw switch operated by a no-voltage release. When the a.c. lighting supply fails in case of trouble, this cluster of lights is automatically thrown over to the battery circuit.

The station is equipped with an air compressor for blowing out the dust from the switches and motors. There is also in the station a 7-in. filter press and pump for purifying oil and a testing transformer of 110/220 to 50,000 volts for testing the oil.

Errors in Arithmetical Operations

By H. E. Weightman

IN MAKING computation for electrical work, such as cost estimation and wiring calculations no regard is usually paid to the apparent and accidental errors that can be made. Such a disregard for errors is usually followed by a waste of time in calculations, which though small and apparently unnoticeably amounts to a considerable part of a day. Due regard for these errors, and the use of shorter methods in the proper place will not only allow more accurate work, and a greater amount of work, but will tend to make one avoid unnecessary accuracy.

No matter how accurately an observation may be made, there must be a figure in the recorded result, expressed in the decimal system, beyond which nothing is known. For instance, if the resistance 1.2345 ohms is measured on a wheatstone bridge which is sensitive to the nearest ten-thousandth ohm, the value of the true figure following the 5, is not only uncertain but unknown. But if the last figure observed is the nearest one to the truth, it is evident that the unknown figure following it must be less than $\pm$ 5. If the resistance under consideration had been taken with a less sensitive bridge the last figure might be uncertain; but if its uncertainty was slight, for instance, if the figure did not probably vary more than one or two units from the truth, it is obvious that it would be retained, for the observed resistance would be less accurate if this figure were omitted.

On the other hand, if the resistance has been taken in such a way that the figure before the last was uncertain, it would be reasonable to omit the last figure, with the customary addition of a unit to the preceding one if the omitted figure was as large as 5.

It is apparent that an error must be involved in any approximate number. If nothing is known concerning the way in which the number was obtained, it may be assumed, for the purpose of calculation, to be correct as far as the figures are given, and hence the last figure may be supposed to be the nearest one to the truth. If this is assumed to be the case, the error in the number cannot be greater than five units in the place beyond the last figure.

These five units in the place beyond the last figure of an approximate number indicate the *maximum apparent error* of the number. Some examples are as follows:

Number	152.3	23.612	0.00134
Max. app. error	$\pm$0.05	$\pm$0.0005	$\pm$0.000005

An error which is actually a maximum one would be expected to occur but rarely. The assumption that the last figure of an approximate number is the nearest one to the truth is unwarranted in many cases. This maximum apparent error therefore, may be used in the consideration of the very uncertain values in such numbers, and it should be so understood when apparent errors are referred to in the discussion that follows.

Errors depending upon mistakes in observations, imperfect processes etc., occuring in electrical data, may be much more serious than the apparent errors of the numbers. These *accidental errors* are not usually evident in the data presented for problems, but they are so important in practice that they should receive some consideration here.

Large accidental errors may usually be detected by the repetition of an operation or determination, whether arithmetical, electrical or mechanical measurement, or otherwise. Hence it is customary to always check computations, to make two or more measurements or determinations, depending upon the necessity for accuracy. The average of a series of close results is usually taken as the true result. However, the agreement of two or more results obtained under the same conditions by the same method does not prove the absence of errors inherent in the method, which are likely to be constant and to be much more serious than errors due to measuring or calculating. On this account, the calculation of the mathematical "probable error," which is based upon the variations of a series of independent observations, and which gives no indication of constant errors, is of little use in ordinary electrical work, and it will not be discussed here.

When the absolute value of an error is given, such as 0.001 volt, 0.05 ohm etc., the magnitude of the number is not considered; but, for the purpose of calculation, it is of utmost importance to know the relations of the errors to the numbers to which they belong. The proportional error is expressed in terms of the number affected by it. For instance, the number 0.0113 with an error of $\pm$ 0.00005 has an error of five parts in 1130, or one part in 226; while the same absolute error in a number 1.1300 is one part in 22600. It is useless, however, to express such uncertain values with the precision that has just been used, hence, the *proportional errors* just mentioned would be given ordinarily as one part in about 200 and 20,000.

When the proportional error of a number is given, the *absolute error* may be calculated very easily. For example, if the number 15.35 has an error of one part in 2000, it is only necessary to divide the number by 2000 to find that the absolute error is about 0.008.

With numbers having errors of the same order, the processes of addition and subtraction require no discussion here, except the statement that the usual apparent errors may be assumed for the results of the operations, because the errors of any two of the numbers may have the same or opposite algebraic signs with equal probability, and therefore, are just as likely to increase as to diminish one another.

When numbers having errors of different orders are added or subtracted, however, the results frequently contain figures that may be discarded as entirely without significance. For example, let us add the following numbers which are assumed to have apparent errors only:

$$\begin{array}{r} 112.4 \\ 70.90 \\ 36.032 \\ \hline 219.332 \end{array}$$

The figure 3 in italics is uncertain, because the value of 112.4 is unknown beyond the first decimal place, and hence this figure

in the sum has a maximum error of five units derived from the apparent error of the number just mentioned. It is not best to omit this uncertain figure, at least for the purpose of further, careful calculation, but the last figure may be discarded and 219.33 written as the sum.

When several approximate numbers are used for multiplication and division, each error in the number used affects the result in the same proportion as it affected the original number. For example, if the number 200 with an error of 2, or one part in 100, is multiplied or divided by another number, say by 10, both the number, 200, and its error, 2, will be multiplied or divided by 10; hence the result of multiplication will be 2000 with an error of 20, and that of division will be 20 with an error of 0.2, so that in each case the error of the result is one part in 100, like the proportional error of the original number. Again, if the number 990 is divided by 10, by 10 + 1 and by 10 — 1, in order to show the effect of an error of one part in 10 in the divisor, the quotients are 99; 90; 110; and it is found that 90 is smaller than 99 by one-tenth of its value, while 110 is larger than 99 in the same proportion, so that it is evident that a variation in the divisor produces the same proportional variation in the quotient, but in an opposite direction.

The largest proportional error among several that may affect the result of multiplication or division, or of both, of several members, is the only one that usually need be considered. For when the others are decidedly smaller they may be disregarded in connection with these inexact values. When there are two, practically equal, larger errors, they are just as liable to have opposite algebraic signs, and thus counteract each other, as to have the same signs, and thus double one another, so that the effect of one of them is the average result to be expected.

Result and Accuracy of Computations

BEYOND the figures that are presumably certain in the results of calculations, there is generally one more or less uncertain figure which is of some importance, because the truth will be more nearly approached by retaining than by omitting it. The apparently certain figures, together with the uncertain one, comprise the significant figures of the result.

It is obvious that all of the significant figures of the result should be preserved, for otherwise, an error would be introduced from the calculation itself. However, it is manifestly absurd to retain figures that have no significance.

The last significant figure of any result, the uncertain figure, may be found from the greatest proportional error, either apparent or assumed, in the number from which the result was obtained, by the simple application of the principle set forth above.

For example, if the number 0.0101 has been used in obtaining the result 0.00124685, and if the maximum apparent error of 0.0101 is assumed, it is to be seen, since the result has a derived error of one part in about 200, that the figure 6 in the above may have an error of about 6 units. Consequently it is the last significant figure, so that the result should be expressed as 0.001247. Another way of finding the derived error is to notice that 124 is about one-fourth greater than 101, and hence it must have an absolute error of about one-fourth larger than the latter, or about 0.6, if the apparent error 0.5 is assumed for 101. In comparing numbers in this way their decimal points are disregarded.

As an example, if the number 0.3261 has the largest proportional error among the numbers to produce the result 65.8742, it is obvious that the fifth figure in the result will have about twice the uncertainty of the unknown fifth figure of 0.3261. Then, if the maximum apparent error is assumed for the latter, an error of ten units in the fifth figure, or one unit in the fourth figure, is the derived error of the result, which should be expressed as 65.87. As a final example let us consider the result, 0.07151 of the operation indicated by $(0.0123 \times 2.567) \div (1.207 \times 0.3660)$, with an assumed maximum apparent error present. The number 0.0123 is the one having the largest proportional error. Since 715 is nearly six times 123, there will be a derived maximum error of about three units in the 5, so the result should be expressed as 0.0715. If an error of two units in the last figure of 0.0123 had been assumed, the result would be 0.072 with an error of a little over one unit in the uncertain figure.

It should be noticed that the last significant figure—the uncertain one—may be often omitted in practice, especially in the realm of design, when the final result is reached and the uncertainty in the figure is a large one. It is very evident that a figure with an error approaching ten units is far less worthy of preservation than one with an uncertainty not much greater than one unit. Decision in regard to this matter must be left to the judgment of the operator, and this should depend upon the object of the calculation and upon the probable accuracy of the data employed as compared with their apparent errors. The main point to be insisted upon is the preservation of all figures that are presumably reliable, and the omission of figures having no significance.

Not all engineering calculations require the same degree of accuracy. When calculating the efficiency of a large transformer it may be of importance to determine whether it is 97.5 or 97.6 percent, so that an accuracy within one-tenth percent may be required. In other cases, as for instance, when estimating the voltage which may be produced by a line disturbance it may be sufficient to determine whether this voltage would be limited to double the normal circuit voltage, or whether it might be 5 or 10 times the normal voltage.

In general, according to the degree of accuracy, engineering calculations may be divided into three classes:

(*a*) Estimation of magnitude; that is, determining the approximate numerical value within 25; 50 or 100 percent. For example, if we wish to know the voltage caused by a line surge it is sufficient to determine whether it is 3 or 4 times the normal or 40 to 50 times the normal line potential. It is immaterial whether it is 47 to 48 times normal.

(*b*) Approximate calculations, requiring accuracy of one or a few percent only. The larger part of electrical problems fall in this class, especially those of design, because the data on which the calculations are based is subject to such wide variations beyond control, as variations in material, mechanical dimensions, and the possibility of accurately measuring such quantities as distance by ordinary means.

(*c*) Exact engineering calculations, where the accuracy is determined sometimes to one-tenth of one percent or greater. Calculations as to efficiency, characteristic curves etc., come in this class.

While calculations are unsatisfactory if not carried out with the degree of exactness which is feasible and desirable, it is equally wrong to give numerical values with a number of ciphers greater than the method or purpose of the calculation warrants. Thus it is not permissable to add zeros, or drop zeros at the end of numerical values, nor is it permissable, for instance, to replace fractions as 1/32 by 0.03125 without changing the meaning of the numerical value, as regards its accuracy. This is not always realized, and in the reduction of common fractions to decimals an unjustified laxness exists which greatly impairs the results. For instance, the dimension of a bushing is stated to be 0.8125 inch and it is known that such exactness is not necessary. With the material the stock list calls for it is an impossibility; the value is an unjustified translation of 13/16-inch.

The writer has known cases where cost clerks figured material and labor out to six or more decimal places where the work under consideration or the material cost was cheap, because they were told that they must be accurate. Too much accuracy is as bad as too little, and an inaccurate man is not to be tolerated. Be as accurate as the means justifies, no more, or no less.

Why Electric Garages are Necessary*

By R. Macrae

BY LOOKING in the dictionary it will be seen that the word "garage" is derived from the French word "garer" the primary meaning of which is to moor a ship to the dock, so that literally, an electric garage is a mooring place for electric vehicles.

The object of this paper, however, is to show that the literal meaning does not apply, and that the place from which an electric vehicle is operated should be something more than a place in which it may be tied up over night.

Usually an electric garage is a place where electric vehicles are housed, charged and washed at a fixed rate per month without regard to the amount of work that the vehicle is called upon to do, but this is not all that a garage should be. The function of the garage is not only to give the vehicle proper care, but also to keep it in proper working order. In other words, its function should be to bring the electric vehicle within the reach of all vehicle users.

To perform this function the garage must be provided with whatever equipment is necessary for making all minor repairs at a reasonable rate and without unnecessary delay, and must also be in a position to supply electric power at a reasonable rate. In addition, therefore, to being a place in which the vehicle is housed, washed and charged, an electric garage that performs its functions is a place from which the vehicle can be operated economically. It relieves the vehicle manufacturers of the expense of maintaining a repair shop in connection with every selling agency and the vehicle user of the expense and annoyance of having the vehicle tied up while a bolt or a small piece of casting is being obtained from a distant part of the country.

With regard to the electric vehicle itself, operating data now available shows that it is as good as perfect if what we are asking for is a vehicle that is in every respect superior to other vehicles now used for carrying on our street traffic. What we are concerned with now are the garaging facilities and if such are satisfactory, there need be no hesitation in recommending electric vehicles for any kind of street traffic.

However garaging facilities at present, are generally unsatisfactory The various schemes of battery maintenance and battery service that we hear so much about and the claim that electric vehicles will never be entirely successful until some such maintenance systems are established, go to show that at the present time batteries are not being properly maintained. In other words, that the garages are not performing their functions properly. The battery however is not the only part of the electric vehicle that has to be maintained, and a battery maintenance system alone will not enable the owner of an electric vehicle to operate it to the best advantage.

The lack of adequate garaging facilities cannot all be laid to our garage managers. Considering how little encouragement the electric garages have received from the manufacturers and the central station men, we may rather be surprised that our garage service in general is as good as it is.

Where we have public garages they have sprung up to fill a want which the users of electric vehicles recognize, but which the vehicle manufactures and central station companies generally speaking have not recognized. The short comings of the garages are almost entirely due to a general misconception of what the functions of the garage should be and to the fact that those who are interested the most in the electric vehicle industry have not fully realized that public garages are necessary in order that the electric vehicle may become generally available. Had the need for suitable garages been clearly recognized at the outset it is quites certain that the electric vehicle industry would not now be lagging so far behind its competitors. Even now when urging the claims of the electric garage the question is sometimes asked "What have the garages ever done for the development of the industry?" If a man wants to operate an electric vehicle why go to a public garage? Why not start a private garage?

There are two reasons why the small garage cannot perform the functions of a garage satisfactorily. The first is, that it cannot afford to maintain an adequate equipment, and the second is the comparatively high rates per kilowatt-hour that the small garage has to pay for electric power, whether the electricity is generated on the premises or is obtained from the central station supply.

When the public is made to understand that an electric vehicle in order to be successful, must be operated under the supervision of someone who knows what an electric vehicle is, we will no longer see the owner of such car taking it to a livery stable or gasoline garage under the impression that it will there receive the proper attention.

Where the electric vehicle is used as a toy the cost of electric power is seldom a consideration that will prevent the electric from being used, and sometimes also when used for commercial purposes the cost of power is a relatively small item. For instance, a one-ton truck doing only as much work as could be be done with one horse should not use over 150 kilowatt-hours per month, which at 5 cents per kilowatt-hour, would be $7.50 per month, or only a little more than hoof pads for the horse would amount to. This same vehicle, however, if operated to its full capacity making 50 or 60 miles every day, might use $40.00 worth of electricity, which would be an item in the cost of operation second in importance only to that of the wages paid to the driver.

Table showing the current consumption and corresponding load-factor in seventeen electric garages.

Garage No.	Monthly Consumption Kw-hrs.	Load-factor in per cent.
1	8800	11
2	5500	15
3	7300	21
4	18000	22
5	7500	25
6	14000	27
7	13000	28
8	8000	31
9	9000	32
10	10500	33
11	20200	33
12	37400	33
13	12500	34
14	13000	36
15	20000	42
16	31500	44
17	23000	46

Five cents per kilowatt-hour is as low a figure as the average garage can now afford to sell electricity for and lower than the small garage as a rule can sell it for.

The majority of central stations now make exceptionally low rates for electric power when used in large quantities and with certain restrictions in regard to the manner in which the power is used, but the small garages are not, as a rule, in a position to take advantage of these low rates.

Sometimes also there is an avoidable waste of electricity in small garages for which there would be no excuse in a large garage. Over-charging of batteries is sometimes carried on as if electric power did not cost anything, and frequently batteries are charged from circuits whose voltage is almost high enough to charge twice as many cells, thereby wasting one-half of the energy in resistance coils. While it is true that the cost of electricity is gradually going down in the most of our large cities, there is no immediate prospect of its going so low as to

*From the author's paper presented at the sixth annual convention of the Electric Vehicle Association of America.

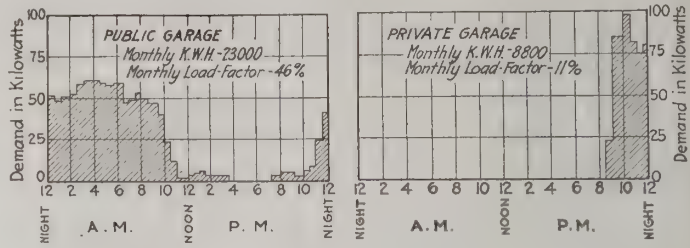
make such a waste of power seem justified under any circumstances.

It is evident, therefore, that in order to get the best that is in the electric vehicles out of them, that we must operate them from the large and properly equipped garages instead of trying to maintain a seperate garage for each vehicle.

In the tabulation herewith are given the figures of power consumption in several electric garages, and it should be noticed how the load-factor varies in the different instances. The diagrams show the daily load curves of two garages. In the case of the private garage the load-factor is 11 percent, which is below the average and in the case of the public garage the load-factor is 46 percent, which is considerably above the average.

Examining this data, it will be seen that there is ample room for improvement in the operation of electric garages in regard to the economical use of electricity, and that under certain garaging conditions it would be impossible for any electric vehicle to make a good showing.

How long before we will have better garaging arrangements



Comparative load curves in two classes of electric vehicle garages

must depend upon the amount of co-operation that the different interests involved bring to bear on the question.

How to Prevent the Hunting of Converters

By William R. Bowker

IN PRACTICE the hunting of converters is very disadvantageous and should be avoided. When a rotary converter is supplied with power on the alternating current side, it runs as a synchronous motor and both are similarly affected as regards speed variation. The converter is in step with the main generators, therefore, any variation in the speed of these machines will also affect the converter. That is to say, the steadiness of operation of a converter depends primarily on a constant rotation of the generators.

Should there be any irregularity in the rotation of the generators, the inertia of the converter armature prevents it from instantly following in step, and the resulting difference in the relative positions of the two armatures causes a change in the phase relation existing between the generator emf and the counter-emf of the converter. The resultant difference between the instantaneous values of these two emfs causes a circulating current to flow between the machines. The direction of this circulating current is such, that the speed of the converter armature is accelerated when its relative position is behind that of the generator, and retarded when in a relative advance position of the generator armature.

This irregularity or pulsation in speed of a rotary converter is known as *hunting,* the effect of which is to cause a fluctuation in the pressure on both sides of the converter. This makes it practically impossible to maintain a constant pressure on the direct current side, at the same time causing sparking and flashing on the commutator, besides throwing the converter out of synchronism, if the hunting is not stopped; hunting may even cause the machine to reverse its polarity.

Reversals of polarity may also be caused by bad synchronizing, and by short-circuits. For these reasons, overload and reverse current cut-outs are now fitted on the alternating current side.

There are several conditions of working which tend to cause hunting, and these may be enumerated as follows: The employment of prime movers having an uneven turning moment;—employing machines having a high momentum;—working machines having a strong armature reaction, with under-excited fields;—a difference in the wave-forms of the generator and converter emfs;—sudden changes of load;—too high resistance in the transmission lines;—short-circuits and defective design. These are all factors that affect the stability of working.

In preventing this tendency to hunt, it is necessary to damp the oscillations or speed variations set up in the armatures through the causes mentioned above; and most manufacturers of rotary converters now fit amortisseur circuits, which have the effect of opposing the tendency to hunt.

During the oscillation in speed, the magnetic flux is shifting across the pole face towards one side of a pole with an increasing speed, and towards the opposite side when the speed is decreasing; and simultaneously with this action the alternating current side of the converter is alternately acting as a generator and as a motor. The fact that hunting is always accompanied by a "shifting field" makes it possible to devise a simple and effective method of preventing it. One method consists in providing the converter with heavy copper grids that surround each pole face, and extend across it in one or more slots; or by placing a sheet of copper between the poles of the field magnets. This is called the amortisseur circuit.

These copper grids act as damping coils, and have the effect of preventing distortion of the main field; at the same time steadying the speed of the generators. When the rotary converter is in perfect synchronism with the supply circuit, these plates, rings or damping coils have no effect; but so soon as the machine begins to fall out of step or hunt heavy currents are induced in them, and bring the armature into synchronism.

Damping coils do not generate a constant opposing torque to that due to the circulating currents, but simply have a damping action similar to that of the copper magnet dampers used in galvanometers, the damping force becoming zero when the value of circulating current becomes constant.

Another method tending to prevent the hunting of rotary converters is to operate the machine with over-excited fields. Hunting may also be checked by switching the starting motor into circuit. Compounding of rotary converters is also desirable where the load is variable, especially under service requirements as demanded by street and interurban railway systems.

The purpose of the compounding is to automatically compensate for the drop in voltage due to line transformer and converter impedance. However, for the reason that a low power-factor is caused by over-compounding, and the fact that substations are customarily connected to the trolley at its nearest point without feeder resistance, over-compounding is not to be recommended. Adjustable shunts to the series field should be provided, instead.

Under heavy load, the series field of a compound converter tends to produce leading currents, which tendency is practically balanced by the reactance, improving the power-factor of transformers, lines and generators when loaded.

Reactances are usually rated in kilovolt-amperes equal to 15 per cent. of the kilowatt rating of the accompanying converters. For example, a 300-kw converter is supplied with a reactance in each phase in which the full load current of 500 amperes, causes a reactive emf of 30 volts or approximately 15 per cent. of the delivered emf. Then a lagging current or component equal to one-third full load causes a 5 per cent. drop in the reactance coil, and a leading component of the current of the same magnitude causes a 5 per cent. boost or rise of voltage.

EDITORIAL

Selling Service First

THE number of current consuming appliances that may be utilized for domestic purposes are constantly increasing. The demand for such equipment is keeping pace with this steady growth and it is because more people are beginning to realize that the utilization of electricity is a large factor in home comfort and economy. This being the holiday season, the old problem of gift giving—what to give—is again confronting the buying public and it therefore rests with those concerned, to suggest practical electrical appliances.

There is probably no better means of effectively impressing the public with the fact that service, moreso than so much current, is really what the electrical companies are selling, than by increased sales of electrical devices of real utility. With the extensive publicity which the do-it-electrically gospel is receiving in the form of nation-wide advertising, there should be no trouble for both the dealer and central station to increase the sales of useful electrical devices. By doing so the popularity of electric service and the advantages of electricity in the home are made more emphatic and the resulting benefits are, of course, mutual.

There are several items, in the form of obstacles, that must be taken into consideration with respect to the sale of current consuming devices. The two more important factors are the first cost of such appliances and secondly the cost of the current necessary for the utility of this equipment. How the first obstacle is overcome and data on the cost of current consumption for heating appliances, together with comments on service as related to these questions in general, are given in different articles in this issue of ELECTRICAL AGE. It seems, however, that a more extensive application of the installment or part-payment plan will go a long way toward relieving the situation. Such procedure must of course result in greater sales because the purchasing power is made easy and it is then within the reach of all classes of buyers. The fact that many central stations have already adopted this policy, is certainly significant.

The item of the cost of current necessary for the operation of household appliances must not be overlooked. It should be remembered that as the efficiencies of lamps are increased, so does the company's existing load become smaller and in order to make up this loss, more current consuming devices must be added to the lines. But what are these new sources of load and how can the load be brought back to normal? These are, of course, the old problems which the commercial men of the industry and constantly trying to solve. The small power load resulting from a more general use of practical devices in the home, is perhaps the largest field now open for new business. The usual obstacle encountered in this respect is, of course, the operating expense, or the cost of electricity. When central stations will begin to sell the current required for such apparatus on a power basis instead of at lighting rates, then the conditions of increased business will be made a reality. The fact that the electrical equipment now available for home comfort and economy cannot be adequately served by the ordinary lamp socket, should not be lost sight of. The greater part of the useful appliances that are really essential to home life can no longer, therefore, be classed as lamp socket devices. Many of these appliances may be grouped under the general heating load and for this reason the cost of electricity necessary to operate them must be low enough to compete with similar gas appliances. Data though meagre, tend to show that cooking and other electric activities in the home are off-peak loads. This class of business is therefore entitled to a reasonable power rate. It is gratifying to learn that several central stations have found this attitude not only reasonable but profitable and have accordingly adopted suitable charges for this service. Among the most recent instances is the reduction in rates made by the Boston Edison Company for this class of business.

* * *

Standardizing Construction Work

RULES and restrictions regulating interior electrical construction work in buildings have, of course, been in vogue almost universally for many years. In this country the standards of the National Board of Fire Underwriters have been followed to a greater or less degree, according to the modifications made by local authorities who control such installations in their particular locality. The results, generally speaking, have been and are highly satisfactory in the sense that a relative degree of safety and proper workmanship is secured when the specifications are followed. This is so because those affected by such regulations are obliged to maintain the standards prescribed therein for their territory. Though such rules and regulations vary in different sections of the country, they have been the means for discouraging the practice of unscrupulous wiremen.

However, outside electrical construction details have, until very recently, been left entirely to the company doing such work. Perhaps this was due to the fact that such constructional undertakings were all really experiments, because high-tension tansmission lines and features of the station to take care of same are relatively recent accomplishments. With the progress of such developments, and the propagation of the data relating to same, engineers were then enabled to decide on methods which were found best in general practice. Since then, Commissions have been organized in various states and these control, with varying degree of authority, the public utility services under their jurisdiction. In many cases the new construction work undertaken by any of

the companies, is subject to the regulation and supervision of the Commission in that territory.

This procedure, however, has not resulted in standard construction methods for central stations and their extensive systems. The fact becomes more pronounced when it is realized that in some localities there are not only competing companies in the field but that they are sometimes operated by the municipality and therefore are not under the control of the State Commission. For this reason and also because local rules governing interior wiring systems are not alike, it is doubtful whether systems installed under such conditions are either safe or adequate on account of the variety of electrical devices available for such use.

Some State Commissions have this very subject of standards in electrical construction now under consideration, but any methods adopted by them will, of course, apply to their territory only.

It is gratifying to learn, therefore, that the work of the federal Bureau of Standards is receiving serious consideration. This body has proposed a national electric safety code which promises a happy solution of the above named difficulties that now confront not only the central station but the contractor. This is surely a hopeful sign. The new code will contain rules for safeguarding life and property in stations and distribution systems, specifications for interior wiring, and regulations for the installation and use of all utilization apparatus. It has been discussed in provisional form by committees composed of representative men in the industry from various sections of the country. These men have critcised it and suggested changes which are now being embodied so that it will represent the ideas of those who are in daily contact with the workings of the old codes.

The Bureau of Standards has no direct jurisdiction and can offer its work only as a model to be used by the states and municipalities in formulating new and better regulations where the old are manifestly unsatisfactory. It is to be hoped that the local authorities will see fit to make use of it; the opportunity to obtain, ready made, an electrical code which is the result of painstaking study and thorough understanding and which represents the newest and best ideas of modern practice is worthy of their attention.

Protection For the Contractor

IN LARGE cities, on account of the many and varied businesses and the people who conduct them, individual license laws are always of benefit. This is especially true when it affects those following a line of endeavor in which, to a great measure, rests the safety of the community. Such laws are always welcomed by the reputable men of that trade. The electrical contractor will therefore conform with the ordinance recently passed in New York City because it is a system under which the unscrupulous electrician cannot exist and is the means therefore, for protecting the reliable contractor. This law in the main, provides for the licensing of the electrical trade in the metropolis.

The Electrical Licensing Board was appointed by Commissioner Williams, of the Department of Water Supply, Gas and Electricity, in accordance with the ordinance which became effective July 16. The Board consists of Hubert S. Wynkoop, chairman, electrical engineer of the Bureau of Gas and Electricity; J. P. Ryan, electrical contractor; Paul McNally, journeyman electrician; Joseph C. Forsyth, electrical inspector; Arthur A. Pope, electrician of the New York Edison Company; F. G. Webber, practical builder, and E. D. Coulter, real-estate owner.

The new ordinance provides that all installations, repairs and alterations of electric wiring or appliances for light, heat or power in any building, may only be done by a person authorized in one of the following ways: First—By a license, which permits him to engage in regular electrical work of all kinds. Second—By special license, which permits him to do the electrical work on one specified building only. Third—By a special permit which permits him to do the electrical work in connection with a single job. A fee of ten dollars is charged for a license, with an annual fee of five dollars for each renewal of the license. Special license or special permit fee is one dollar.

The ordinance also empowers the Commissioner at any time by an order in writing, for good cause shown, to "modify, suspend or revoke any special permit issued pursuant to this chapter, and in like manner, but upon recommendation of the License Board, he may modify, suspend or revoke any license similarly issued."

In the case of wiring already installed: if, after inspection it is found to be unsafe, the Commissioner has the power to order the service disconnected, and the wiring sealed until changes have been made.

Penalty for non-compliance with the provisions of the ordinance is a fine of $50.

The Licensing Board, which meets weekly, has adopted the following rules:

(*a*) An applicant for a license or a special license shall be required to submit with his application a sworn statement which shall give the age of the applicant, if an individual, shall inform the Board of the period of the time such applicant shall have been in business as a master or employing electrician, and shall give a list of at least twelve complete equipments for electric light or power which he has installed.

The Board reserves the right further to examine such applicant, either orally or in writing, as to his fitness and qualifications.

(*b*) Applicants unable to comply with the above conditions shall be required by the Board to submit to a written examination.

(*c*) Applications may be made in the name of an individual, a corporation or a co-partnership. In the case of a corporation or a co-partnership, the applicant shall state the name, age and official position (with such corporation or such co-partnership) of its representative who will submit to examination.

(*d*) Where two or more buildings are under one ownership or one management, the person employed by such owner or by such management to supervise the installation, alteration or repair of electric wiring or appliances in such buildings shall be licensed; or else, the electrician in each building must hold a special license.

Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Advantages of Electric Drive

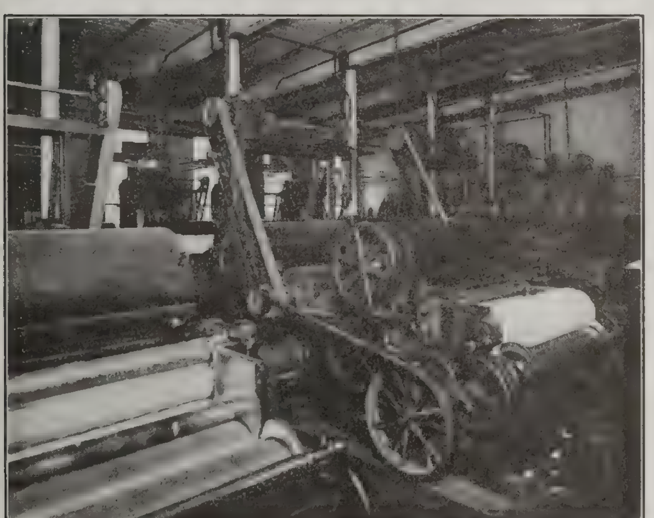
Motor Application in Textile Mills

By J. R. Olnhousen

THE application of electric power to textile mills was started about twenty years ago, and today there are in the neighborhood of 45,000 motors furnishing nearly 750,000 horse-power to the textile mills of the United States. The development of alternating current systems and the success of the induction motor have made possible this extensive growth.

Up to a comparatively short time ago it was always a question in the minds of the textile people whether mechanical or electrical means of transmitting power should be used, but today due to successful methods of motor application this question no longer arises, the main problem being which of the various methods of motor application would be the most advantageous to employ.

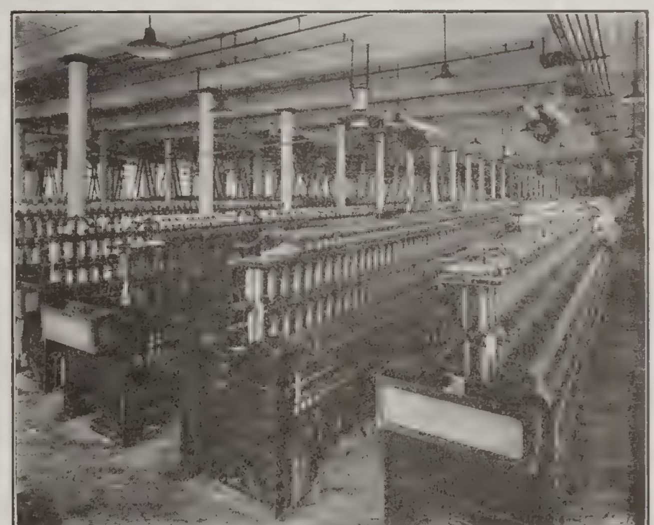
Originally the machines were grouped and driven by motors from 100 to 300 hp. capacity, retaining to a large extent mechanical drive features, and in some cases the entire mechanical drive was retained, one large motor taking the place of the engine. But as the individual motor drive was tried out and the small induction motors improved in design, the placing of a motor for each machine, with a few exceptions, is the latest approved practice of all first class textile engineers, and this practice has been adopted by the majority of textile mill managers.



Individual Westinghouse motors mounted on "A" frames and driving Pickers in a Southern plant.

The principle advantages of electric drive in textile mills are increased production and better quality of production. This is obtained by keeping a uniform speed on the driven machine, which in turn is accomplished by the present motor drives that have been developed, consisting mainly of individual drive except in a few cases where the group drive is retained.

With the old mechanical drive there was always present the slippage of the belt and the whipping of the shaft caused instantaneous variations in the speed of the driven machine, averaging 15 percent. Tests in a great number of mills have shown this figure to be exceeded, in some cases the variation being 30 percent. This meant that when the machines were running below their rated speed there was a loss in production, while when running above their rated speed there was an increase in the number of broken ends as well as additional wear and tear on the machines. With the present motor drive this is completely eliminated. It has also been proven by tests that uniform speeds on the driven machinery has made it possible to increase the speed over the rated speed and still not have the number of broken threads or the wear and tear on the machines as great as that which formerly obtained with the mechanical drive.



General view of a spinning room, showing Westinghouse motors driving four frames. Note the double extended shafts and the two belts on each pulley.

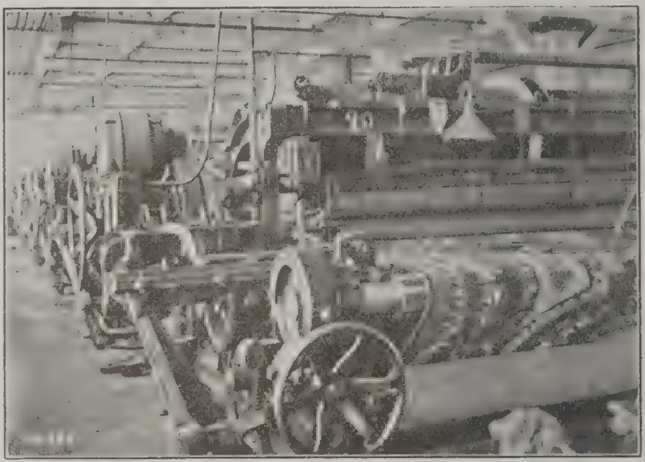
The variation in speed which inevitably resulted with the old mechanical drive caused differences in the thickness of the yarn, so that there was an unevenness in the quality of the finished

product. The uniform speed now secured on the different machines by means of motor drive eliminates this variation in thickness of the yarn, so that the finished product is of better quality.

Safety to employees, better lighting, and less spoilage of goods by the absence of oil drippings, are other advantages which result from the elimination of overhead shafting and belts.

Another advantage, and one which is appealing more to mill owners every day, is the ease with which records can be made and cost determined. It is necessary to know every detail before one can advise what is the best thing to do. If the mill man takes an indicator card off his engine, as was the case with the old mechanical drive, how near accurate would his cost records be on a certain part of his mill? If these individual records are not accurate, he can hardly claim that his total records are, and it is a difficult matter for him to go ahead improving his major conditions when he does not know what the minor conditions are. With a meter arranged to read the consumption of each motor or group of motors, he can know, not only the amount of power that every process has taken, but can even tell how the operators are operating their particular machines.

In regard to comparative costs of an electrically driven mill and mechanically driven mill, it has been found that in first cost the electrically driven mill will run slightly more than the mechanically driven mill. However, the cost of the complete electrical equipment is only about 10 percent of the total cost of the mill, and the yearly cost of power is from 4.5 to 5 percent of the total cost of the manufactured products. It may be readily seen, therefore, how a small increase in production will easily pay for the small increased cost of the electrical drive.



A nine-foot carpet loom driven by a 3-hp individual motor geared to the loom.

Actual experience with up-to-date motor driven mills is that from 5 to 7.5 percent increase in production over the mechanical drive is obtained, which shows a very good return on the increased investment.

What the Power-Factor Means

By A. P. Broadhead

ONE of the greatest losses in the generation and use of alternating current is the power-factor, and the induction motor is nine times out of ten the cause; particularly motors of large size running at slow speed. High speed induction motors when running fully loaded will have a power-factor of possibly 85 per cent., but such cases are rare.

According to the design and fundamental principles upon which the motors are designed, they must be excited. For instance, direct current motors and synchronous motors require direct current for field excitation, although the synchronous motor runs on an alternating current line. In the case of induction motors the necessary field excitation is taken from the alternating current system so therefore the induction motor takes two currents from the same line, one for field excitation and one necessary for the motor to perform its work.

The accompanying vector diagram will illustrate this:—

B-E is the working current or that necessary to enable the motor to carry its load. *B-A* is the exciting or magnetizing current. It is wattless and lags 90 degrees behind the supply voltage. *A-E* is the total current taken from the supply line. *B-E-A* is the lag between the current and voltage and its cosine is known as the power-factor. Now consider *B-E* as full working current on a particular motor and the load is reduced to half. Then, *D-E* is the working current, and *D-C* is the exciting current, of the same magnitude as at full load; *C-E* is the total current. *D-E-C* is the lag between the current and voltage and it is noticed to be a larger angle than that of full load, therefore a poorer power-factor.

The amount of magnetizing current of an induction motor is practically constant at full loads, therefore the smaller the load, the smaller the working current and as shown by the diagram, the greater the lag then the lower the power-factor. Without some outside help the power-factor of an induction motor can never become unity as is also illustrated in the diagram, simply on account of the magnetizing current from the same source.

The current for induction motors; that is, the working current and magnetizing current are supplied by the generating plant. It can easily be seen, therefore, that the generating plant which has a large number of induction motors on its line, has to bear a great loss all the time, so that the generators and transformers, while supplying the large magnetizing current become overheated, not because of the amount of work the motors are doing, but the great current they are drawing to excite them.

By improving the power-factor you can readily see how the losses on such a system can be greatly reduced, because losses caused by the wattless current, either at the generating plant, substation or transmission line increase with the square of the current.

It is a hard matter to convey this thing to the minds of mill managers; that in order to get the most economical service out of an induction motor it must be fully loaded. In other words, the motors must be selected with care and if a certain machine takes half horse-power to drive it—the size of the motor should be ½-hp.

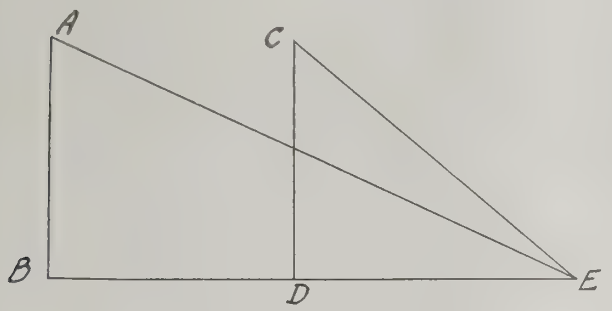
Nine times out of ten when asked why a 10-hp motor was purchased when a 5-hp motor would carry the load, the answer is "Well, by getting it larger it will not get heated and burn out." Standard induction motors are designed to carry 25 percent overload continuously without injurious heating and still the trade is skeptical.

The higher a consumer can keep the power-factor of his load, the more economical it is for him, because power companies are fully aware of the evils of a poor power-factor. Naturally, the companies must protect themselves from this loss and base their charges on the customers' power-factor.

Some companies charge a flat rate per horse-power per year provided a power-factor of at least 85 percent is maintained, while others charge per kilowatt-hour with a rebate if the power-factor is above a certain percent which is stated in their contract.

There are two ways of improving or correcting the power-factor of a system. First by the use of a synchronous motor or a rotary converter running either idly or carrying a steady load. By keeping the field excitation comparatively high it will supply a magnetizing current to the line for the support of the induction motors and release the generator of that particular load.

Of course, there are certain advantages and disadvantages which have to be looked into. In a large transmission system, with a synchronous motor or rotary set on a particular feeder, care must be taken in the adjustment of the field strength of the sets, or the customers on the line will suffer from either too high or too low a voltage. Do not have a leading power-factor in such cases; keep it just below unity and no trouble should be encountered.



Vector Diagram illustrating the power-factor

Now it must also be thoroughly understood that after a synchronous motor or a rotary converter is started and the field set produces a unity power-factor, that setting is only sufficient for the magnetizing current of the induction or other motors running at that particular time, so if more induction motors are started, the power-factor will lower, showing that more magnetizing current has been drawn and the field strength of the rotary or synchronous motor must be increased.

The above is not intended to convey the idea that the presence or operation of a synchronous motor or rotary converter on a line is going to increase the power-factor of individual induction motors because they are in no way influenced. It is the generators and transformers on this line that are benefited by not having to supply the large amount of magnetizing current for these induction motors. This is supplied by the rotary or the synchronous machine.

The second way of improving the power-factor of induction motors is the result of somewhat recent invention and is known as a phase advancer. This machine is made by leading manufacturing companies and is intended for use of individual motors, particularly large ones. The theory of the phase advancer is in general as follows:

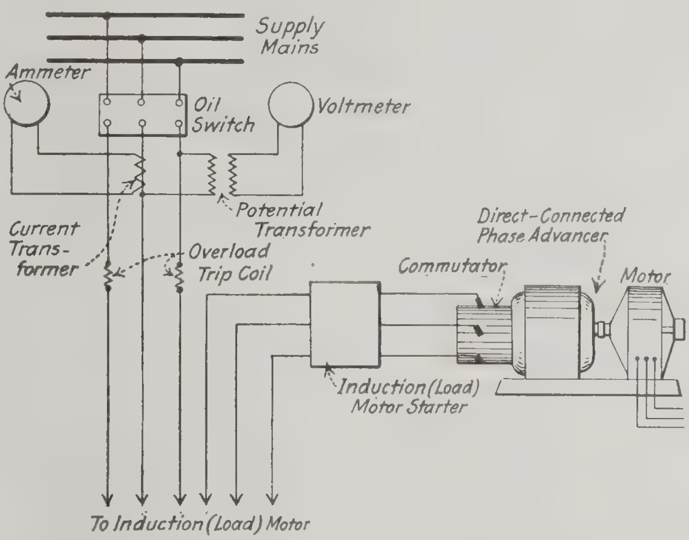
A special polyphase commutating machine, the rotor of which has a drum winding which lies deep in slots in an iron core to provide a good path for the magnetizing field and connected to a commutator like a direct current armature. There is no stator to this machine—the armature is protected by a shield which surrounds it. Regular carbon brushes are used on the commutator and the whole is driven by a small motor coupled to the shaft and resting on the same bed-plate. This commutating machine is connected electrically to the slip-rings of the induction motor and has to supply the magnetizing current for the motor.

Now let us suppose that the polyphase rotor current of the motor should flow into the advancer which, while stationery, acts as a choke-coil and causes a reactive drop. This for a given current depends on the frequency or upon the rate at which the phase advancer rotating field cuts the winding and the reactance, therefore the lag decreases if the rate of cutting is reduced by the rotating winding in the same direction as the field and at synchronous speed finally becomes zero.

If the speed is increased above synchronism the reactance attains a negative value and the phase advancer acts as a load so then the current is advanced. The current which flows into the phase advancer has a frequency which is proportional to the slip of the motor to which it is connected amounting usually to 1 or 2 cycles per second and the speed of the advancer has a value corresponding to 30 or 50 cycles. Under these conditions a leading current—a wattless current—will result and this provides magnetizing current for the induction motor, so that the only current the motor draws from the line is its working current. As the magnetizing current supplied by the phase advancer is wattless no torque has to be exerted. Therefore, it is not necessary to have a stator on the advancer.

The induction motor to which a phase advancer is connected does not lose its asynchronous character. The slip increases with the load so that the motor will not hunt or fall out of step as might be expected and the power-factor will remain at approximately unity during all ranges of the motor load.

Electrical contractors should be thoroughly acquainted and conversant with the nature of the power-factor and co-operate



Wiring diagram of a phase-advancer used for induction motor regulation.

with the central station manager. The power solicitor could during slack times study into the power-factors of the company's customers and induce them to purchase a phase advancer for their largest motor and explain to them the advantage gained. Such actions would increase good feeling between the customer and the power company and tend to build up efficiency.

❖ ❖ ❖

An Inexpensive Outfit

An ingenious use of material which at first glance would seem to be valueless is that utilized in a portable transformer outfit belonging to the municipal lighting plant of Crawfordsville, Ind.

This emergency outfit proved itself of great utility for testing trial power installations, break-down service and for temporary installations at country fair and similar services.

The running gear was originally of one of the fire engines owned by the city. When the engine was scrapped, to be replaced by more modern equipment, the wheels and frame were secured by the superintendent of the electric lighting plant.

The electrical equipment consists of two Westinghouse single-phase distributing transformers, each of 25 kw capacity. Leads are brought out to a rack so that either single-phase or polyphase can be obtained at potentials of 110 and 220 volts.

Purchasing of Power-Station Lubricants

PERHAPS there is no material purchased for power plants that produces a greater variety of specified service demands than the purchase of lubricants. Certain phases are recognized in one and totally omitted in another. The following is an abstract from a comprehensive report of the committee on Power Generation, read before the American Electric Railway Engineering Association at its recent convention held at San Francisco.

In the purchase of lubricants, one company for instance investigated specific gravity, percentage of compounding, free acid, viscosity, flash point, evaporation, smell, price, coefficient of friction and temperature rise with pressure per square inch equivalent to pressure per square inch in the bearing. Tests on machine oils with price varying 50 percent may show the same temperature rise and coefficient of friction but one oil, the cheaper grade, emulsifies, the other does not. It has been pointed out also in reference to specifications that it is possible to compound good cylinder oils using a certain percentage per month in conjunction with the cheaper grades and thus producing a lubricant with a flash test of over 500 deg. and a fire test of over 650 deg. The prices paid by the company quoted are cylinder oil 28 cents per gallon, turbine oil 25 cents and engine oil at 13 cents and their acceptance of any oil is contingent on its successful run on a trial.

Another form of specification is even more simple. It simply specifies that the cylinder oil shall have flash enough to overcome the steam temperature where it is intended to be used, also that the viscosity which varies in the cylinder oils from 145 to 170 at 212 deg. Fahr. The question of gravity is left to the discretion of the manufacturers but they point out that the most important point in this oil is to have one in which the petroleum fats have not been destroyed. This, of course, must be determined by distillation. (Fats do not occur in petroleum oils.) The usual non-emulsifying property of the oil supplied is the last stipulation in this specification. Another specification submitted allows for the use of two distinct cylinder oils both of which give satisfaction, although it is explained that different engineers on the same system vary in their opinions as to the value of these oils, each preferring their own choice of these separate oils. Many specifications on cylinder and lubricating oils for engines and turbines were also considered.

It was brought out in the discussion that a rigid specification covering the physical and chemical characteristics of lubricants is at the present time inadmissible.

The purpose of this report therefore is to show the results of a number of successful applications of lubricants and to give the characteristic of the oils used. A suggested form of specification has been drawn up along these lines and is appended hereto.

Owing, however, to the absence of complete data on the characteristic of lubricants, it was recommended that this important subject be further studied by the committee.

SUGGESTED FORM OF SPECIFICATIONS FOR LUBRICANTS

Specification for Furnishing Lubricants for The ...... Co., Power House Requirements for ...... Months.

The different lubricants to be delivered in suitable drums or barrels distinctly labeled so that there may be no mistake as to the nature of the contents or the purpose for which the specifications designate their use. All vessels used are to be removed when empty at suitable intervals at the discretion of the purchaser or company representative. The material furnished under this contiact must be delivered at the place and time as directed by the purchaser.

The right is reserved to extend the time named in this contract for......days, proper notice to be given the contractor.... days before the expiration of this contract. The delivery of the lubricants to commence........ and be continued until .... When notified of the monthly requirements to be furnished by the contractor and if for any reason there may be a larger or smaller quanity required within a variation of........percent, the delivery shall conform to these requirements upon advice from the proper person representing the purchaser.

TURBINE OIL TO STAND:

Gravity test, 29 deg. Baumé.
Flash test, 480 deg. Fahr.
Fire test, 520 deg. Fahr.
Cold test, 15 deg. above Zero.
Viscosity test, 200 deg. @ 70 deg. Fahr. Saybolt.

TURBINE HIGH PRESSURE CYLINDER OIL TO STAND:

Gravity test, 24.5 deg Baumé.
Flash test, 570 deg. Fahr.
First test, 635 deg. Fahr.
Cold test, 30 deg. above Zero.
Viscosity test, 200 deg. @ 212 deg. Fahr.

TURBINE LOW PRESSURE CYLINDER OIL TO STAND:

Gravity test, 25.5 Baumé.
Flash test, 500 deg. Fahr.
Flash test, 560 deg. Fahr.
Cold test, 30 deg. above Zero.
Viscosity test, 160 deg. @ 212 deg. Fahr.

ENGINE OIL (PALE COLORED) TO STAND:

Gravity test, 31 deg. Baumé.
Flash test, 410 deg. Fahr.
Fire test, 475 deg. Fahr.
Cold test, 20 deg. above Zero.
Viscosity test, 215 deg. @ 70 deg. Fahr.

Lubricating Graphite Grease

Lubricating grease to consist of about one part of an amorphous graphite pigment of good quality in about two parts of a mixture of mineral grease and a metallic soap pigment. The material must be as free as possible from ash, showing more than 15 percent of ash, which must be of a micaceous nature and be free from grit. The material must be so compounded as to soften with out flowing at 100 deg. C. It must be free from resin or resinate. It must be equal in lubrieating properties to standard sample as determined by practical comparative tests.

Unless otherwise specified, the material is to be delivered in friction-top cans of 25 pounds capacity, properly labeled with the name of the material, the capacity of the can, and the name of the manufacturer.

Mineral Lubricating Grease

COMPOSITION: Lubricating grease to be a homogeneous mixture consisting exclusively of from 80 to 90 percent of a mineral oil of specific gravity ranging from clean animal fats and the proper amount of lime for saponification. The material to yield not more than 2 percent of ash and to be free from fillers, uncombed lime, gritty substances, rosin oil, rosin or resinates, and from mineral of fatty acids, alkalies, or any deleterious impurities.

CONSISTENCY: The material to flow without separating at a temperature of from 50 to 80 deg. C., and when heated for one hour at 110 deg. C. to lose not more than 2 percent of its weight.

LUBRICATING PROPERTIES: To possess lubricating properties determined by practical test in lubricant-testing machine as follows: When fed at the rate of 1½ grains per minute through a grease cup, on friction surface of a brass shoe having 9 sq. in., bearing surface, sustaining a load of 1,926 pounds against a

steel journal 6 in. in diameter revolving at a surface velocity of 405 feet per minute, it shall maintain an even temperature of not more than 60 deg. C. above surrounding normal temperatures, and the coefficient of friction shall be constant during the last hour of the run shall be less than 0.013.

PURPOSE: Mineral lubricating grease under these specifications is intended for use in compression grease cups for bearings.

Mineral Oil (Kerosene)

Samples of each lot, taken at random, will be tested photometrically after burning one hour in lamps fitted with No. 1 hinge burners, Marcy's patent, the standard employed being a a standard Hoefner lamp. After burning five hours longer, the lamps will be again tested to determine any change in the intensity of the light. The flame must be of at least 6 candle-power and must show no material change in intensity during the five-hour interval.

The samples must show a flash test of not less than 115 deg. Fahr. and a fire test of not less than 140 deg. Fahr. The flash and fire tests are to be conducted in a closed tester of the "Tagliabue" type.

The oil will be tested for the presence of free acid. Litmus paper immersed in the oil for five hours must remain unchanged. The specific gravity must not be greater than 0.800 for Eastern oil and not greater than 0.813 for Western oil at a temperature of 60 deg. Fahr., to be purchased and inspected by weight. The oil must burn steadily and clearly, in a standard lamp or lantern, without smoking and with a minimum incrustation of the wick for a period of at least seventy-two hours.

Inspection and Delivery

Before the acceptance the oil will be inspected. Samples of each lot will be taken at random, the samples well mixed together in a clean vessel, and the sample for test taken from this mixture. Should the mixture be found to contain any impurities or adulterations, the whole delivery of oil it represents will be rejected, and is to be removed by the contractor at his own expense.

The quantity delivered to be determined by weight—the number of pounds per gallon to be determined by the specific gravity of the oil at 60 deg. F. multiplied by 8.33 pounds, the weight of a gallon (231 cubic inches) of distilled water at the same temperature.

Definitions

COHESIVENESS: The property of the particles of oil to adhere to each other and their ability to withstand the tendency of the metal to cause this disruption.

ADHESIVENESS: The property to stick to anything else. Both of these properties may be present. Any deficiency in either of these properties may render any lubricant useless. This also applies to an unequal development.

VISCOSITY: Is the harmonious combination of the above properties and this blending determines the value of an oil as a lubricant. Viscosity also refers to the body or fluidity of an oil. Determination is made with an instrument called a Tagliabue Viscosimeter.

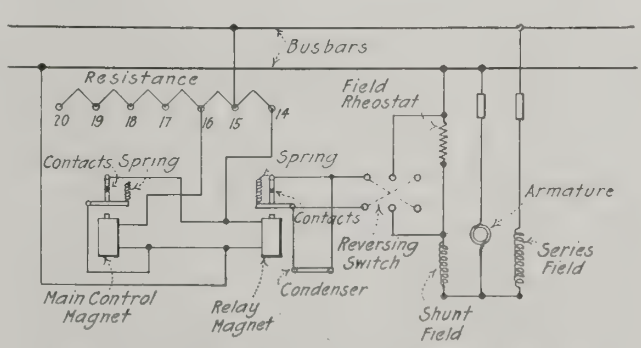
FLUIDITY: Is the property of the lubricant to flow and this flow is caused by the particles separating and re-adjusting themselves. It is obvious that a correct balancing of these different properties makes up the requirements for the different purposes of lubricants and these adhesive and cohesive properties combined with the right amount of active discriminating fluidity determines the value of any particular lubricant for any given purpose and that is further determined by the ability of the lubricant to carry pressure in any direction without the metals coming in contact.

TEMPERATURE: That is the ability of the oil to maintain its lubricating properties with the least amount of friction at any given reasonable range of temperature and of necessity this must vary, as one condition may demand an oil to maintain its viscosity at very low temperature. An oil that loses its fluidity under these conditions of low temperature loses its efficiency in proportion to the extent to which the flow is affected or in higher temperature the fluidity may be accelerated to such an extent that the same detrimental effects are in evidence although from diametrically opposite conditions. In determining the selection of a lubricant we may remember oils are divided into two classes, fat or fixed oils and the essential or volatile oils. The fatty oils are derived from animal and vegetable sources and are a mixture of three substances of similar properties, two of them at ordinary temperatures are solid stearine and margerine and the third a fluid oleine. The last is the property that gives fluidity and smoothness to the lubricant. Both kinds of oil, animal or vegetable or composed of carbon, hydrogen, and oxygen in almost equal proportions and the choice for service lies between the two as for instance—an oil that emulsifies is unfitted for turbine use but for cylinder lubrication an oil that emulsifies must be used. On the above lines, the following form of specification is presented; consideration in view of the foregoing must be given to the following points: Viscosity, Free acid, Flash point, Fire point, emulsifying properties, nature of compounding as mineral and animal fats, price, delivery, time and place, and vessels to be used, evaporation, and deterioration.

Connections for a Voltage Regulator

IN THE illustration herewith is shown diagrammatically the connections of the simplest form of regulator to be used for maintaining normal voltage on a continuous current generator. It is assumed that there is but one supply circuit and all connections therefore, are made directly to the bus-bars. A condenser is shown connected across the relay contacts in order to minimize their arcing, but ordinarily such device is not needed across the main control contacts because the current handled by them is usually small. The reversing switch is used for reversing, at regular intervals, the direction of the current flow through the relay contacts so that their wear may be equal and uniform.

The blocks 14 to 20 include resistance used to limit the current through the main and relay coils. Each magnet has an armature, one end of which is hinged. In each case the spring tends to hold the contacts together against the effort of the energized coils, to keep them apart; at any voltage exceeding normal, the coils prevail and at any voltage below normal, the springs prevail. From block 15 of the resistance, one path through section 15-16, includes the main magnet coil; another path through section 15-14, includes the relay coil. The main contacts are connected across the relay coil; the relay contacts are connected across the field rheostat of the generator.



Elementary diagram of a Direct Current Generator Voltage Regulator.

If the voltage for any reason falls below normal, the main control magnet is weakened and its contacts permitted to close, thereby short circuiting the relay coil. The relay contacts then close and short-circuit the field rheostat, thereby increasing the field current and restoring the voltage to normal. The instant the voltage tends to exceed normal, the strengthened main magnet overcomes its spring, parts the main contacts, removes the short-circuit from the relay coil, the contacts of which then open and thereby remove the short-circuit from the rheostat. This tendency of the voltage to alternately go slightly above and then slightly below normal, as a result of the flexible functioning of the regulator, keeps the armatures in continuous vibration and the voltage at the value for which the regulator is connected.

It may be appreciated that the magnetism of the generator must respond promptly to the functioning of the relay contacts, otherwise regulation will be unsatisfactory. It is in order to obtain this required sensitiveness to changes, that the generator field rheostat resistance is turned in to a point that reduces the field current to a value corresponding to an unsaturated condition of the generator's magnetic circuit; a small change in the field current then produces a comparatively large change in the field flux hence in the voltage of the generator. If the relay contacts include too much resistance, they will burn; if they include too little, regulation under load is apt to be too sluggish. —*E. C. Parham.*

Cooking by Electricity

Examples of Range Installations

VARIOUS opinions are held by commercial managers as to the advisability of the electric heating load in the form of ranges on the company lines on account of its relation to the peak-load periods. Conditions are of course different in many sections of the country and so are the customs of the people with respect to the time in which ranges are used. Then again in many localities the cost of cooking by electricity is so much higher than similar results which may be attained by the use of gas.

However the advantages of electric appliances over any other form are becoming to be more recognized every day. We therefore find that regardless of cost many are resorting to the electric range for reasons of simplicity, cleanliness and safety. Installations of this nature are not limited to the club or hotel kitchens but they may also be found in apartment houses and such institutions as hospitals.

Electric Range in the Southern Indiana Hospital. This is one section of a unit serving 1,000 persons. Complete unit represents a connected load of 56.5 kw.

In the illustration herewith is shown one section of a Simplex 6-oven electric range. The complete unit, consists of another similar section, the two being set back to back. With the addition of a small electric bake-oven, this equipment provides for 1000 persons in the Southern Indiana Hospital. Each section is 12 ft. long and 31½ in wide, consisting of three ovens with the following dimensions: 24 in. wide by 26½ in. deep and 16 in. high.

The part of this equipment which is shown in the illustration has mounted on its top, a total of ten round hot-plates, three of them are 8-in., five of 15-in. and two of 10-in. diameter. The utensils furnished are as follows:

Two 9 gal. kettles for 15 in. hotplates.
Two 5 in. double boilers, with 8-gal. outer vessels.
One 3½ in. kettle for 10 in. hotplates.
One sauce-pan for 10 in. hotplate.
One frying-pan for 8 in. hotplate.
One 4-qt. double boiler for 8 in. hotplate.

This section, complete, represents a connected load of 23.5 kw. On the top of the other section comprising this cooking unit, are mounted seven 18 by 24 in. griddles with rims each provided with a metal drip cup. The total connected load is 33 kw.

Another interesting installation is the Simplex equipment in the Engineers Club of Boston. The electric range, as illustrated provides for the 700 members of the club. The maximum seating capacity of the regular dinning rooms is 130 persons and the banquet hall takes care of an additional 150 persons. Guests have been served here with as many as 3475 meals per month, while the help has received 2800 meals. The cost of the service in this club is about $180.00 a month and includes the current for elevators. Allowing and deducting $30.00 for elevators, leaves $150.00 for the operating cost of the range, a small bake-oven, hot closets and a toaster.

This equipment consists of a range 12 ft. long having three ovens. Each oven has an inside working space of 21¼ in. wide, 27 in. deep and 16 in. high. Above the ovens, beginning at the right-hand end of the range are mounted a broiler, two frying kettles, two griddles and eight hotplates. Special utensils, made of heavy copper in nickel plated finish, are also provided. The broiler, frying kettles and griddles are incased in a cabinet closet in front of three Russia-iron rolling covers, the back part of the cabinet being connected to a ventilating flue. Drip pans for the griddles and broilers are provided in the form of small drawers in the nickel-plated front.

Each heating unit on the range is provided with fuses and controlled by an independent 3-heat snap-switch. The switches are mounted on the front of the shelf over the range, and above each switch is a ruby glass signal-lamp. The shelf is used for storing utensils, etc., and is not heated. The range has three extra plug receptacles to which may be connected additional appliances if so desired.

This equipment is on a 3-wire, 100-volt system. The total connected load, with everything on at full-heat, is about 30 kw. The maximum actual load under extreme service conditions as recorded by a wattmeter, is 18 kw. The conditions of club service, where special order meals are served at all hours, up to midnight, and some heaters kept hot ready for instantaneous use, are particularly unfavorable to economical running. Nevertheless the consumption of the range, per meal per person, has averaged but slightly over ½ kw-hr.

The electric range, for domestic purposes, is gradually finding its way into more homes. This is especially true where the central stations are adopting special cooking rates. With reasonable rates for such electric service, cooking by electricity may very readily compete with a similar gas service. One of the most recent cases of rate reduction for electric cooking

heating and refrigeration is the instance of the Edison Illuminating Company of Boston. Here the rate has been brought down to 10 cents per kilowatt-hour for the first 10-hours, and two cents thereafter. With this schedule the cost of electricity for cooking is brought on a par with gas at 90 cents. In some of the sections served by this company, gas costs as high as $1.40 per thousand cubic feet and for this reason it is expected that the use of the electric range will become more popular.

Electric cooking equipment in a Boston Club where more than 6,200 meals are served during a month at a cost of about $150.00.

In this respect it might be well to examine the data as compiled by the Simplex Electric Heating Company, together with their comment, as follows:

Many central stations have failed to make cooking rates because of fear of high maximum demand in relation to the rating of the installation. Records show not only that the load is entirely practical but very desirable. The average maximum demand of the apartment house installations listed in the tabulation, is only 15 percent of the rated load. The record of a total of 83 Simplex ranges, in four seperate installations, taken from the books of the central station supplying them, is certainly interesting and instructive.

Location	Cost and Kw-hr. per person per month — Cooking Rate 3c	4c	5c	Kw-hr.	Kw-hr. per person per Day	No. of Ranges	Rated Load kw	Max. Demand kw.	Max. Demand to Rated load—per cent.
Worcester, Mass.	$ .84	$1.12	$1.40	28.0	0.93	16	77	13.5	17.50
Great Falls, Mont.	1.01	1.34	1.68	33.6	1.12	21	110¼	13.5	12.35
Salt Lake City, Utah	0.76	1.01	1.27	25.3	0.85	24	77	11.5	15.00
Anaconda, Mont.	0.87	1.16	1.45	29.0	0.97	22	92	—	—
Average	$0.87	$1.16	$1.45	29.0	0.96	—	—	—	15.00

Electric cooking results in four apartment houses. The figures are for groups of ranges in actual operation.

Builders now are in the relation to Electric Cooking they were some years ago when questioning the use of electricity for light in apartment houses, because of cost to tenants. The data herewith shows what can be accomplished in apartment houses with reliable apparatus. It points the way to those who will reap advantages of being first in their local field to povide for electric cooking.

From the figures presented it will be seen that in operation, even groups of electric ranges show a small maximum demand ratio with respect to the rated load. From the foregoing it is safe to say that one kilowatt-hour will supply the cooking requirements for one person during one day.

Reflectors for Show-Window Installations

By John A. Hoeveler

SHOW-WINDOW construction and methods of trimming, in recent years, have become quite well standardized. The drawing herewith represents in sectional view, the average closed-in window as now used by the better grade department stores, dry-goods stores, men's clothing stores, etc. The usual height from floor to ceiling is about 10 feet; the depth, plate glass to background, 7 feet; and the height of trim on background, 7 feet. The trim is carried out with the low and flat display placed at the front of the window, and the higher vertical objects at the rear. Consequently a "line of trim" may be drawn, to indicate approximately the surface that we should endeavor to uniformly illuminate. With this average line of trim determined, it is an easy matter to calculate the shape of light distribution curve required to give uniform lighting.

In Fig. 1, the curve *A* represents the light distribution from a single lighting unit that will give a uniform intensity of illumination on this assumed line of trim. The candle-power values indicated are calculated to give 9-foot candles. It will be noted that the curve should embrace approximately the angle $-5°$ to $+75°$ (where the negative angle means the angle to the left of the nadir). This is a distinctly non-symmetrical distribution of light that is very difficult to obtain, but nevertheless can be closely approximated.

The mirror reflector has inherent characteristics which makes possible the attainment of these results to a remarkable degree of exactness. A mirror is a specularly reflecting surface, and within certain limits the distribution of light can be varied. Because of the necessity of employing corrugations to break up the images of the filament and eliminate the resulting streaks and stria in the illumination, perfect control of light in accordance with the law of regular reflection is not secured.

However, securing the proper distribution of light is but one

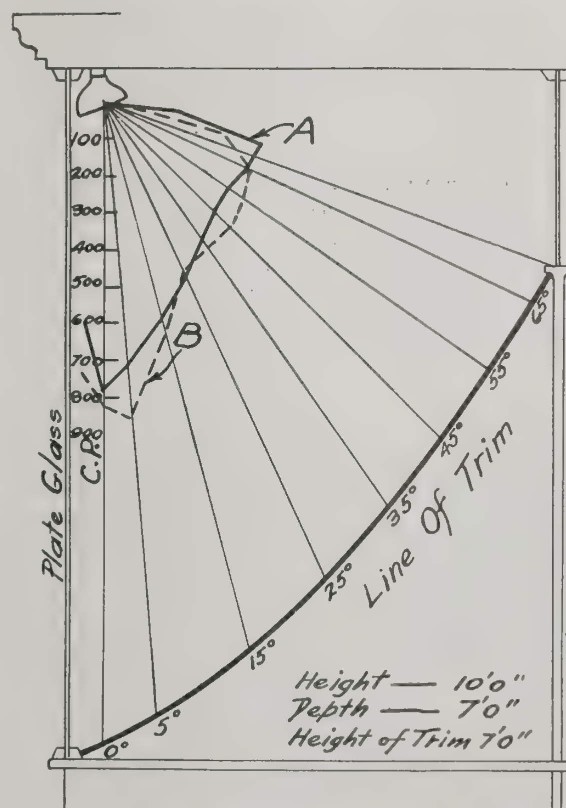


Fig. 1—Cross-sectional view of a typical closed-in show-window. Note the "Line of Trim."

portion of the problem. Other factors must be satisfactorily solved. For instance, it will be noted that the upper part of the window background is usually of glass, to permit some daylight to enter the store. Where the glass is clear, the light-

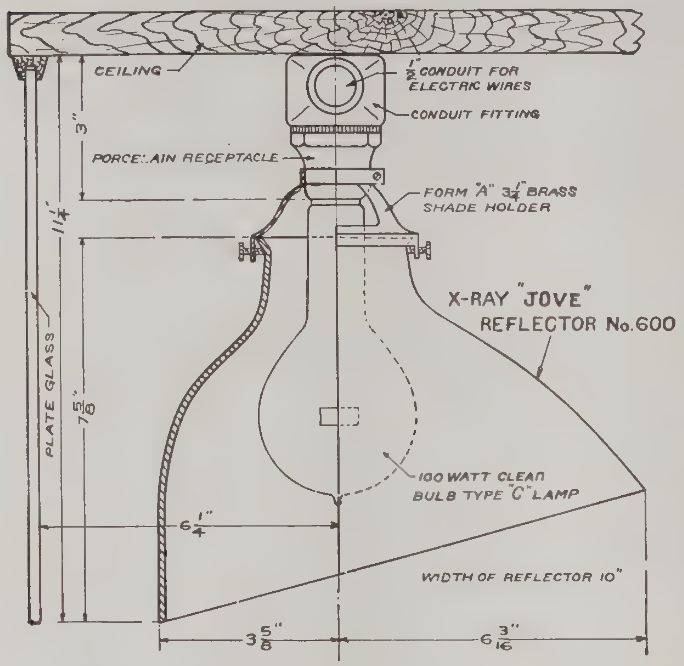


Fig. 2—Contour of reflector for 100 watt gas-filled lamp for show-window installation.

ing units would be visible from the store interior, unless the reflector is designed so as to conceal the lamp filament from the view of the customers within. Then in order that sufficient light may be delivered to the upper part of the background, the reflector must partly be open at the front. In practice, therefore, this opening must be sufficiently restricted to conceal the filament of the lamp and at the same time allow a sufficient volume of light flux to escape in a nearly horizontal direction to illuminate the upper part of the background. With the vacuum style tungsten lamp, the ideal results represented by curve *A* in Fig. 1, could not be very readily secured. In order to light sufficiently high up on the background, it was necessary to expose a considerable portion of the long filament, resulting in a deficiency of apparent candle-power directly downward, and too high an intensity on the background, as well as the possibility of a direct view of the lamp filament from within the store. The concentrated coil filaments of the new gas-filled tungsten lamps have simplified the attainment of these results.

Curve *B* of Fig. 1, shows the light distribution secured with a 100-watt type "C" gas-filled tungsten lamp and a silvered mirror

Angle	Candle Power Curve A R	Candle Power Curve A L	Curve B R	Angle	Candle Power Curve A R	Candle Power Curve A L	Curve B R
0°	820	820	820	90°	15.1		
5°	850	735	790	95°	7.1		
15°	650	500	660	105°			
25°	505	248	473	115°			
35°	485	127	333	125°			
40°				135°			
45°	480	57	254	145°			
55°	454		200	155°			
65°	425		36	165°			
75°	345		3	175°			
85°	46.3			180°			

Reflector X-Ray No. 600
Holder Form 3¼"A"
Lamp Type "C" Mazda
Watts 100 W.P.C. (Hor) 0.80
Plotted by W.H.R. Test No. 6392
National X-Ray Reflector Co.
Engineering Department
CHICAGO
Date 8-14-15.

Table giving test data of light distribution as plotted in Fig. 3.

reflector of special design. Fig. 2 shows the contour of this reflector and the relative filament position. Its light distribution curve approximates the ideal curve *A* very closely, and for all prac-

tical purposes is equally as effective. The front surface c "nose" of the reflector is carried down sufficiently so that th lamp filament is concealed from view within the store, fo most positions. Since the reflectors are usually installed co siderably above the normal line of vision, this reflector afford good protection to the eyes of the customer, where the top c the background is clear glass.

So much for the plane perpendicular to the trim. In th plane parallel to the trim, the light distribution should prefe ably be symmetrical. Inasmuch as the lamps and reflectors practice are closely spaced along the front of the windo from 18 to 36 in. centers, then in order to secure good diffusi and ample brightness, a fairly concentrating distribution in th plane is desirable. Curve *B* of Fig. 3 shows one-half of th symmetrical curve in the plane parallel to the glass, for the typ of silvered mirror reflector shown in Fig. 2 with the 100-wa gas-filled lamp. Curve *A* in Fig. 3 is the light distribution in th plane perpendicular to the glass front drawn to the same sca

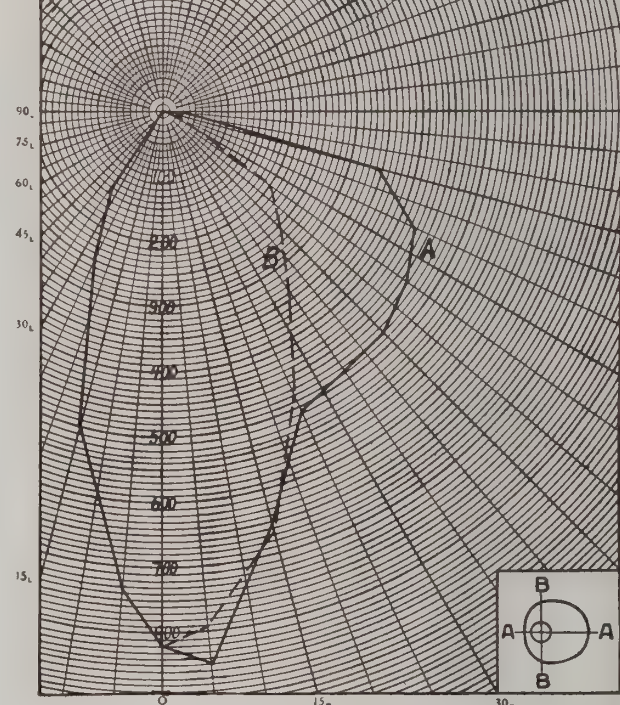


Fig. 3—Diagram showing light distribution curves of silvere mirror reflector and 100 watt gas-filled lamp.

Experience shows that this reflector is admirably adapted all show-windows in which the height of trim in comparison the height of the window is fairly great, and which have height varying from one to one and one-half times the dep As will be noted, it cuts off as sharply at the window's edge as possible, without sacrificing intensity of illumination at t front of the window. Thus it will be seen that the maxim flux of the lamp is utilized in illuminating the trim. A d system of very fine spiral and coarse radial corrugations eli nates filament images, streaks of stria. It is found that w the concentrated coil filament very much finer corrugations a necessary to adequately break up the light rays. This dual s tem of corrugations secures results which for all practical pu poses equal to those secured with an etched or roughed surfa and at the same time the reflector obeys the law of regular r flection more closely and is more efficient.

✣ ✣ ✣

Vacuum Cleaners.—Shoe dealers are buying electric vacu cleaners to clean the rugs and thus prevent the scuffing a scratching of new shoes while they are being fitted.

Problems in Electric Practice

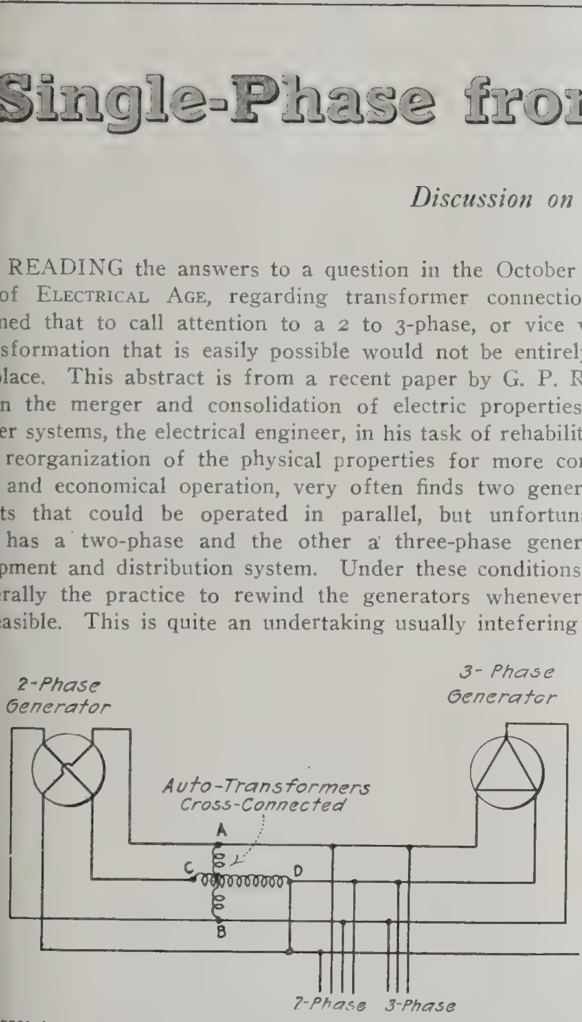
The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Single-Phase from Polyphase Systems

Discussion on Transformer Connections

N READING the answers to a question in the October issue of ELECTRICAL AGE, regarding transformer connections it eemed that to call attention to a 2 to 3-phase, or vice versa, ansformation that is easily possible would not be entirely out place. This abstract is from a recent paper by G. P. Roux: "In the merger and consolidation of electric properties into rger systems, the electrical engineer, in his task of rehabilitation id reorganization of the physical properties for more convennt and economical operation, very often finds two generating ants that could be operated in parallel, but unfortunately, ie has a two-phase and the other a three-phase generating uipment and distribution system. Under these conditions it is nerally the practice to rewind the generators whenever this feasible. This is quite an undertaking usually intefering with



Wiring diagram of 2- and 3-phase generators for parallel operation on a 4-wire distribution bus through cross-connected auto-transformers.

service, and is a useless expense if the rewound equipment only temporary. The parallel operation of two-phase and ee-phase generators or of a two-phase and three-phase sys- n, or better yet the simultaneous distribution through four es of two-phase and three-phase energy, can be effected in a y simple and economical manner, with no alteration or nge in the mode of operation of the existing equipment."

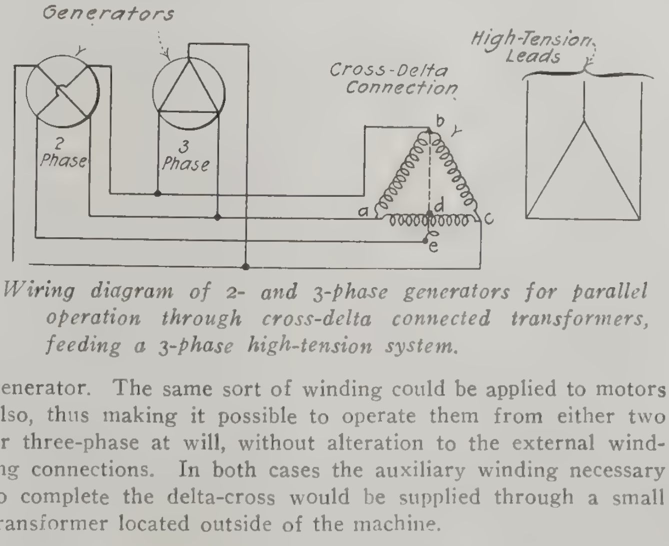
he case of paralleling two and three-phase generators is not nething that requires a lot of new equipment to effect its ration nor is it one that is untried. Mr. Roux cites two ems where it has been used; one having had it in use for ears and the other 3 years.

n one of the diagrams is shown an arrangement which cons of two auto-transformers, one of which has a 50 percent and the other has an 86.6 percent tap. The 50 percent of transformer *A-B* is connected to the 86.6 percent tap of transformer *C-D*. Then phase 1 of the two-phase generator is connected to the end terminals of transformer *A-B*. Phase 2 is connected to the end terminals of transformer *C-D*. Then the three leads from the 3-phase generator are connected to *A*, *B* and *D*. The diagram shows from which points the taps can be made for taking off either 2-phase or 3-phase leads, and it is evident that single phase current can be taken very easily also. This arrangement, however, is a little more difficult to effect than that shown in the other diagram for the reason that a Scott connected auto-transformer is required for the former.

The arrangement which is shown in the accompanying illustration is equally as flexible in operation as that previously mentioned, but is much easier to obtain than the first case. This second arrangement requires a set of three ordinary single phase transformers connected in delta, one of which has a 50 percent tap connected to a small transformer which need only be of 13.4 percent of the capacity of the larger transformers. This small transformer which corresponds to *d-e* is connected as a booster for 13.4 percent, being 100 less 86.6 percent, of the voltage across any of the larger ones.

Thus it will be seen that *a-c* and *b-e* represent the phase in quadrature for the 2-phase part of the system while the 3-phase portion works normally. Neither of the two systems when connected together in this manner suffer from any unbalancing.

Attention is called to the fact that it is possible to wind armatures of alternators with a cross-delta connection so that both two and three-phase currents can be taken from the same



Wiring diagram of 2- and 3-phase generators for parallel operation through cross-delta connected transformers, feeding a 3-phase high-tension system.

generator. The same sort of winding could be applied to motors also, thus making it possible to operate them from either two or three-phase at will, without alteration to the external winding connections. In both cases the auxiliary winding necessary to complete the delta-cross would be supplied through a small transformer located outside of the machine.

It will be seen that this system of connections is possible of a great number of useful combinations and answers all requirements for either 2-phase or 3-phase operation.—*Arthur C. Hewitt.*

REGARDING the discussion in the October number relative to obtaining single phase from the 3-phase, the contributor of the second article makes the following additional comment: The writer recognizes the error involved in the method suggested, and would say that this fallacy was fallen into because of having employed a similar scheme for preserving balance on a two-phase system whereon the entire load was single phase which it was inconvenient to divide.—*T. E. Tunison.*

Problems for Solution

The following are offered for your discussion. If you have information on these subjects or if you have had experience in these matters, then here is the chance for you to help those in difficulty. Published answers and discussions are paid for.

Grounding—In overhead line construction work, what is meant by the ground-wiring of the poles? What is its object and how is it practically carried out? Illustrate method by diagram.—*J. N.*

Trip Coils.—A coil for tripping a transmission line oil switch in case of trouble is connected in series with the line. It consists of a round coil that has a porcelain sleeve fitting snugly inside, with a laminated iron rod of 1-in. diameter and 3 in. long which fits loosely inside the porcelain sleeve. The iron core sits on a glass rod or tube about three feet long and extends vertically down to a little trip contactor and in case of trouble or over-load, this makes contact and causes the solenoid to open the oil switch. Please give formula for finding the amount of current passing through coil, and how to figure the turns. The line carries 44,000 volts.—*J. F. M.*

Divided Circuits.—In the diagram herewith is shown a 2-battery grounded circuit. What is the current flowing in each part of the system and the total circuit? How do the voltages divide over the two grounded paths from each battery? What is the formula for computing this?—*E. R. H.*

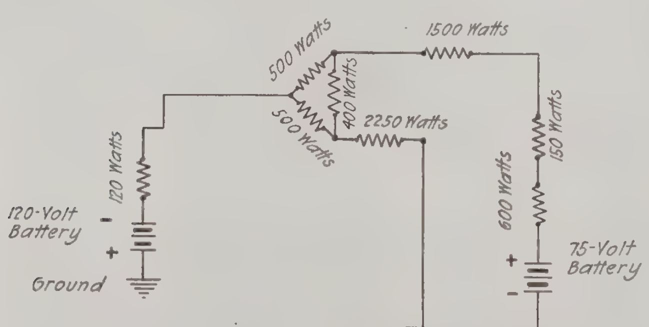


Diagram illustrating problem on divided circuits.

Four-Wire Systems.—What are the advantages of a 4-wire 3-phase transmission system. How are the wire sizes computed and what connections are necessary for simple-phase and 3-phase services? Please assume a condition and give example. —*W. S.*

Boosters.—What is the function of a booster? When and why should one be used and what are the wiring connections for same?—*S. F.*

Ground Potential.—If one leg of a three phase transmission line is grounded as at *A* in Fig. 1, will a potential indicator give a deflection if suspended from the grounded leg? If the leg that is grounded be isolated, say, 500 ft. from the other legs, will the indicator give deflection? What does the potential indicator show, voltage to ground or between phases?—*U. F. N.*

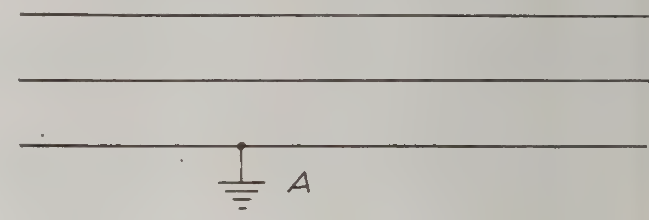


Diagram illustrating question on ground potential.

Transmission and Distribution.—An hydroelectric plant located 12,000 ft. above sea level transmits its power to mines and smelters for a distance of 100 miles, and these are at a 14,000-ft. elevation. Current is generated at 2300 volts and stepped up by three banks of water cooled transformers wound with a ratio of 20 to 1. There are two lines which parallel each other on the same towers; the wires are number 1 B. & S. gage stranded, of hard-drawn copper and spaced six feet apart on 12-in. top petticoat insulators. The first 18 months the plant was operated in delta, but was recently changed to Y with grounded neutral with the hopes of reducing the disturbances caused by lightning. The lines are protected at each end and at the middle by lightning arresters.

Can you offer any suggestions for an improvement, as considerable trouble is still experienced from lightning? What will be the charging current on lines when in Y and when in delta? —*J. E. M.*

A Too Sensitive Ammeter

CONTACT-MAKING voltmeters are well known devices because they are so generally used in connection with automatic feeder voltage regulators. They pilot the motor by means of which the "boost" or the "lower" is changed in order to keep the voltage constant under changing load conditions. The contact-making ammeter works on the same principle but it is not so well known, because its field of application,—that of maintaining constant current under changing resistance conditions,—is more limited.

One application of the contact-making ammeter is to the automatic regulation of the current of electric furnaces; the current is regulated by means of motor operated electrodes. With normal furnace current the ammeter contact-arm floats between two contacts. If the current increases from normal by more than a predecided amount for which the contacts have been adjusted the contact-arm touches the one or the other of the two contacts and accordingly as one or the other is touched, the motor is caused to rotate in one direction or in the other, thereby advancing or retarding the electrodes accordingly as the current must be increased or must be decreased.

On an electric furnace that was used for making fine steel, trouble was experienced, due to instability of the electrodes The contact-making ammeter was so sensitive to minor current variations incident to furnace internal processes, that the contact-arm was touching one or the other of the pilot contacts nearly all of the time. This kept the pilot motor continually starting, stopping and reversing when there was really no need of it.

The addition of a dash pot to the contact arm, eliminated the trouble and greatly decreased the duty of the motor.

Wattemeter Connections

IN ANSWER to the query and referring to the wiring diagram herewith, the polyphase wattmeter records correctly whether the power-factors be high or low, and the loads balanced or unbalanced. The wattmeter consists essentially of two elements which are both connected to the same shaft. Each element is, in effect, a single phase wattmeter. The current coil of the one element carries the current in its own phase plus that in the phase with no current coil connected in it; this current is displaced from it giving the resultant current a phase displacement from that of the current in the phase with the coil connected of 30 degrees. The same condition obtains in the other element of the meter, the resultant current being 30 degrees out of phase with the current of the phase in which the wattmeter coil is connected. In the one case the current lags behind the voltage in the shunt coil of the meter, in the other leads.

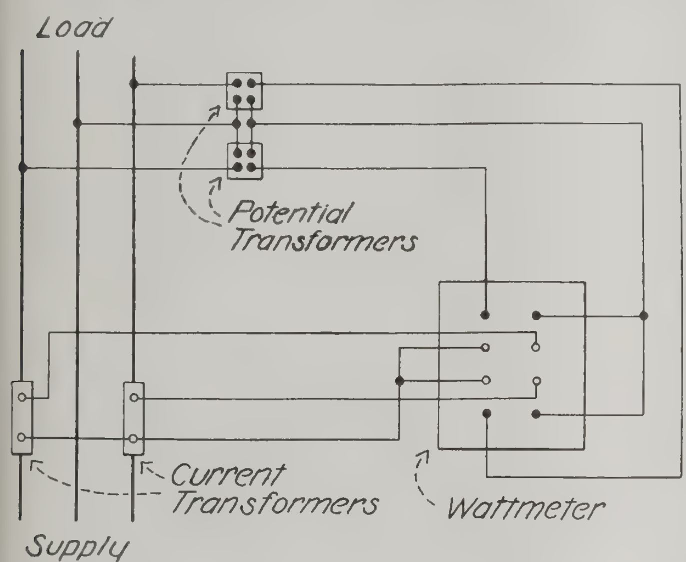


Diagram showing correct wiring connections for a polyphase wattmeter.

At unitly power factor, that is a power factor of 100 percent, the current is thus seen to lag 30 degrees behind, the voltage in the one coil while in the other coil to lead by 30 degrees. The torque in each element is the same therefore, and the total torque is the arithmetical sum.

Consider now that the power-factor is 90 percent instead of 100 percent. A power-factor of 90 percent means that the current lags, or is displaced, 30 degrees behind the impressed electromotive force. Under these circumstances the current now lags 60 degrees behind the voltage in its shunt coil in the one element, whereas in the other element the current and voltage are in phase. The torque of the one element is thus reduced and that of the other increased. The total torque is still the sum of the two elements. Suppose, further, that the power factor of the load is 50 percent, which corresponds to a phase displacement between current and voltage of 60 degrees. In the one coil the current flowing is now 90 degrees behind the impressed electromotive force, whereas in the other coil the current is lagging 30 degrees. The one element, with the 60 degree displacement, sets up zero torque, while the other has the same torque that it would have with unity power-factor, since the current is displaced the same amount, or 30 degrees. The total torque is, of course, the sum of the torques set up by the two elements, since they are connected to the same shaft. The meter now records but half what it would record at unity power-factor because only half the meter is exerting torque. This simple discussion proves that the polyphase wattmeter records equally well on low as on high power-factors.

Either three or four wires may be used for the secondary wiring, and it is immaterial which. Three wires are usually preferred because there is a saving of wire and labor, and a smaller conduit may be used—an important feature in some instances.

Where the secondary wires from the current transformers are long, and where several instruments are connected in the circuit it is often advisable to use four wires and not the common return because the resistance and inductance can thus be reduced. Speaking generally it may be said that the use of three wires or of four is merely a matter of individual choice. With certain connections of the current transformers the third or common return should have larger cross section than the other wires because the current is greater.—*K. R.*

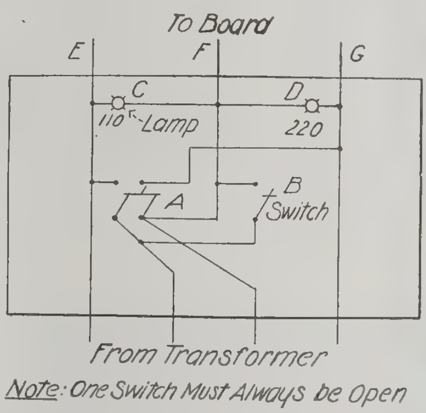
❖ ❖ ❖

Transformer Switching Device

THE description following is of a simple contrivance which can be attached to the low voltage or secondary side of a transformer for changing the connections from 3-wire to 2-wire or vice versa for test purposes or special service. A glance at the sketch will make the idea quite clear.

A board, the size of which may vary according to the requirements, is used to support the switches and indicating lamps on the front and the wiring on the back.

To obtain 3-wire, 110 — 220 volt service, open switch *A* and close switch *B*, then the two lamps *C* and *D* will burn brightly and the voltage between wires *E* and *F* and *G* will be 110 and *E* and *G* 220 volts.



A Transformer Switching Device—Diagram of wiring connections and finished panel as actually installed. Lamps and switches are mounted on face of board; all wiring is on back of board.

To obtain two wire 110 volt service open switch *B* and close switch *A* then lamp *D* will go out and between wires *E* and *G* and *E* and *F* the voltages will be 110. Lamp *C* will burn brightly.

It is very important to note that switches *A* and *B* cannot both be closed together without causing a short circuit.—*A. P. B.*

❖ ❖ ❖

Speed Changing in Induction Motors

THERE are five methods by which the speed of an induction motor may be changed, namely:

(1) Varying the applied emf.
(2 Changing the rotor resistance.
(3) Varying the number of poles.
(4) By cascade operation.
(5) Varying the applied frequency.

The usual means under the first method is to use a compensator or autotransformer. This method although simple does not give very satisfactory speed regulation. In this case the power-factor and the efficiency decrease with the decrease in speed.

In changing the rotor resistance a constant speed is not obtained over the torque range of the machine, but changes with the torque. As in case (1) the efficiency decreases with the speed.

The third method is feasible when only two speeds are desired for as the number of speeds increase the necessary wiring becomes complicated and bulky. The power-factor in this case is not affected to a very great extent, but as it is necessary to open the supply circuit while making the change, variation in primary current and fluctuations in voltage are a frequent result.

Where two motors are available they may be operated in cascade, the two rotors being rigidly connected. The stator of the first is connected to the supply circuit and its rotor, of the slip-ring type, feeds the stator of the second machine; the rotor of which is usually connected to an adjustable Y resistance. This method finds application in railway and special heavy machining tools where speed changes are frequent and considerable power is involved. The power-factor and efficiency of the two motors in cascade are less than in a single machine of equal capacity.

The fifth method, that of varying the frequency, is usually impracticable. In any case the method of doing it is easily obvious.—*H. E. W.*

Designing a Sign Flasher

IN SECURING a definite speed for the drum of a flasher where the drum itself does not serve as its own pulley, the determining factors are the speed of the driving motor, the ratio of the reducing gear and the relative sizes of the pulleys on the motor and on the drum. A change in diameter in either of the latter pulleys will result in a change of speed of the drum when the speed of the motor remains the same. Hence the size of the drum will be independent of the speed required and will be determined only by the materials at hand and ease of construction unless the current to be handled is large enough to require special attention to the nature and capacity of the current carrying parts.

Having once decided on the size of the drum, however, the lengths of the contacts must bear definite ratios to its circumference. Since the drum must make one complete revolution for each complete cycle of the flashing periods, the one in question (see Electrical Age, October, 1915) must revolve once in 22 seconds ($5 + 3 + 10 + 4 = 22$) or 2.727 times per minute. The lengths of the periods will then be definite fractions of the total cycle, the number of seconds in periods being the numerators over the common denominator 22. It is evident, then, that the lengths of the contacts must bear these same ratios to the circumference of the drum, as follows: $5C \div 22$; $3C \div 22$, etc., where C is the circumference.

The following may be of help to the constructor: Since the usual high speed of the ordinary small motor would require a drum pulley of very great comparative diameter to obtain the low speed of 2.727 r.p.m., some sort of reducing gear will undoubtedly be required. One or more bicycle wheels running on their ball bearings will serve the purpose admirably where the speed of the motor is subject to fine adjustment. Small battery motors will answer the purpose and can be operated from a small stepdown transformer furnishing 6 volts or thereabouts from the secondary. With a one inch pulley on the motor a speed as low as 28 r.p.m. can be obtained on one wheel. The speed of the motor, however, does not seem to respond with such nicety to a change in resistance as is the case when direct current is used. A flasher constructed on a bicycle wheel has been observed to operate with a hardly sensible change of speed for over three hours on a small battery motor running on three dry cells.

Inch-wide strips of tin foil, in two or three thicknesses, will serve experimentally on a wood drum as contacts and may be used for some time in service if carefully pasted on without ridges and not subject to poor brush contact and currents over eight or ten amperes.—*Orion Hurst.*

Answer on Telegraphy

THE following may prove of interest regarding the above question of the Phillips Code. This code is published in book form and retails for one dollar.

It was compiled by Walter P. Phillips, general manager of the United Press, for newpaper purposes. It was designed as a means for making the labor of the sending operator easier, while at the same time, more news could be carried over the wire. In this way the newspapers are enabled to receive a more complete report of the current events. It is easy to learn and remember.

The following is an example of its application. The sending operator would transmit thusly: *John Jones WS SAIK TSM BI A poxmn D HUR.* The receiving operator would write it, using a typewriter, owing to the great speed necessary:

"John Jones was shot and instantly killed this morning by a policeman in the House of Representatives."

One who is skilled in the use of the Phillips Code, even though he did not understand shorthand, could "take a speech" quite readily.—*J. B. Dillon.*

Importance of Transformity Polarity

Question.—One terminal of current and potential instrument transformers is painted red to indicate polarity. What use is made of this, and what is the result of disregarding it?

Answer.—The direction of current flowing from the secondary of any transformer into the secondary circuit depends upon the polarity of the transformer leads. In instruments such as ammeters and voltmeters, where the mechanical reaction is due to a flux proportional to either current or voltage, the polarity of the transformer is immaterial; but on the other hand in instruments such as wattmeters, power-factor meters—in fact, any instrument where the torque is due to both current and voltage—the direction of the currents flowing through the respective coils of the meter, hence the transformer polarity, is of importance.

Knowing the relative polarity of the secondary leads, from the identification marks of red paint, greatly facilitates connecting meters correctly when using a wiring diagram; and where no diagram exists it is not a difficult matter to connect up correctly if the principle of operation of the meter, or the convention employed by the manufacturer, is understood.

The effect of connecting a meter incorrectly, that is interchanging one pair of leads, differs with the different meters, but it may be said in general that if the indication of the instrument is considered positive when correctly connected a negative indication will result when reversing the current in either coil. Reversal of the currents in both coils has, of course, no effect upon the indication.

Single-phase meters have been considered so far, or the single-phase elements of polyphase meters. In grouping two or more series transformers, care should be taken to see that the polarity of the respective secondary leads is correct, otherwise in certain cases—where the current of one transformer passes through the other—dangerously high voltages may be induced.

One of the most useful applications of an electric motor about the household, according to an electrical man who has made a special point of having his own home equipped electrically "to the last gasp," is the motor-driven exhaust fan installed in his kitchen. By setting up a draft from the dining room and living quarters into the kitchen, and discharging thence through a window into the open air, cooking odors are effectually kept out of the rest of the house. The fan and motor are mounted in the upper pane of one of the kitchen windows, and the installation is kept in operation while food is being cooked, both winter and summer.

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Results of an "Exchange" Campaign

A FEATURE well worth considering in planning special sales of electrical devices, is the plan recently employed in a sales campaign by the Chattanooga (Tenn.) Railway and Light Company. The merits of advertising and circularizing are considered with respect to actual results. The contract agent of this company, L. J. Wilhoite, explains the system and its accomplishments, as follows:

The plan of our recent Flat Iron Sale, in which we exchanged old coffee pots and flat irons for new electrical devices, allowing a credit of one dollar on such exchange, is based on the idea that folks—especially women folks—like to cash in on their possessions.

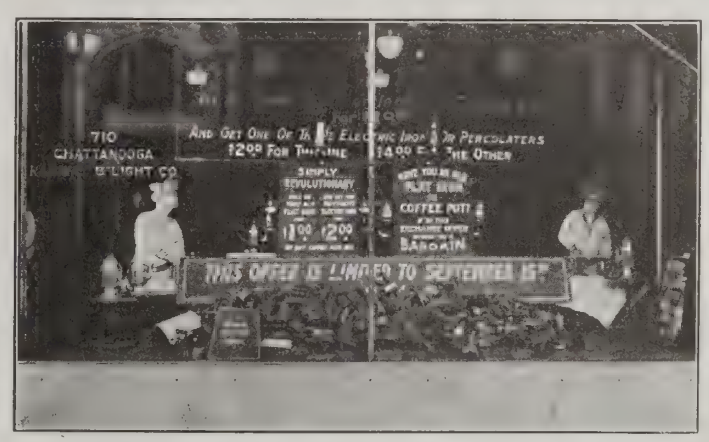
One form of advertisement used during the "Exchange" campaign.

Did you ever notice how a man will carry around an old street-car transfer in his pocket for days after its value as a trolley ride has long since passed into ancient history? This is just one example of how human beings like to hang on.

Again, if you have ever sold power you will recall how that little factory owner on the outskirts of your town, with the isolated plant, turned down your offer to save money. He did this even after you had actually convinced him that you could deliver the merchandise in a nice little money-saving package. And why so? Simply because he had paid money for the equipment and although you had shown him how it was eating him up, he still hated to turn loose.

A good many of this same kind have not let go as yet because they are human, and all things human love to hold fast to that which they have. These owners would sell out cheap—dirt cheap—but they can not stand the idea of seeing junk tickets tacked on to their pile of old machinery.

It is the same way with flat irons. You can offer people $3.50 electric irons, guaranteed for a thousand years, for only $2.50, some will avail themselves and some will not. Those who have good sad irons will not, because they can not figure what to do with the old sad irons, and so they will go on doing it the old way, your do-it-electrically arguments to the contrary, notwithstanding. Thousands of women keep on ironing like grandmother did, not because they hold her memory in any particular reverence, but because their old-fashioned sad irons stand between them and the do-it-electrically idea.



Show-window of the Chattanooga Railway and Light Company announcing the exchange offer and showing the pile of old flat-irons.

This sad iron barrier to electric ironing was built by the women themselves, and that too at their own expense. Accordingly they are not going to tear it down and throw it aside to reach any Electric Iron Sale under the sun—no matter how loudly you proclaim it.

These women will agree with you, no doubt, that your proposition is better than theirs, but to them an acknowledgment is by no means a reason why they should change over. They own the sad irons and, to express it as they do, they "Can't afford to throw them away." With them it is not so much a question as to the cost of an electric iron as it is a problem of disposing of their sad irons to good advantage. Show them how they can do this, and the cost of the electric iron within itself will not be a barrier.

Your offer of a $3.50 iron for $2.50 is no solution of the problem of what to do with the old sad iron, and until you solve the problem you can't expect to get the business.

On the other hand if you buy their old flat irons, the problem is solved and the cost of a new electric iron is a comparatively easy obstacle to get over. We believed this idea strong enough to try it out during the summer of last year. This past summer the plan worked even better than it did last.

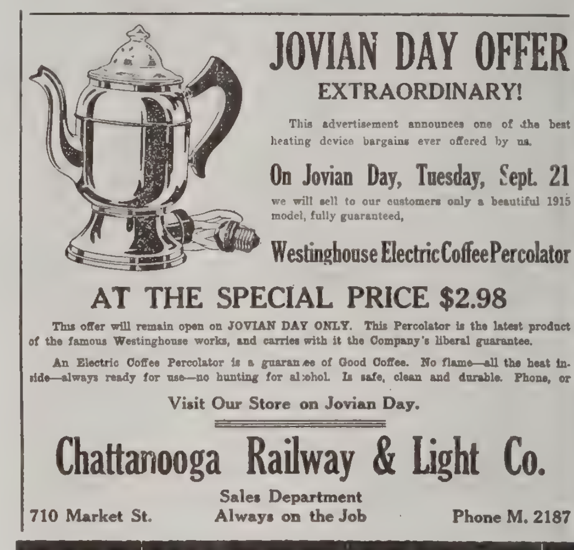
Last year we confined our exchange offer to irons only. This year we included percolators, allowing $1.00 for any old coffee pot in exchange for a $5.00 percolator. We inaugurated this sale on August 26 and continued it until September 15. During this period we expended for advertising $187.30, practically all of this amount being devoted to newspaper space, with the exception of our usual show window displays, our publicity efforts being confined to the two local daily papers.

This was contrary to our plan of last year when we expended some money for circular letters, envelope stuffers and printing on the reverse side of our statements to consumers. However from a comparison of the results obtained last year with those obtained this year, we feel that the better plan is to spend practically all of the advertising appropriation for newspaper space, rather than splitting it up for circularizing, envelope stuffing, and other miscellaneous methods.

During the Sale 302 six-pound electric irons were sold. The gross profit on these sales was barely adequate to meet the advertising expense incurred, but as a consequence we have an added load of 150 kilowatts which will net us an annual income of approximately two thousand dollars.

Percolator sales during the two weeks were not encouraging, only 10 percolators being disposed of. We really believe that the percolator offer in a measure hurt the value of our newspaper advertisements from the standpoint of electric iron sales, and feel that the space devoted to percolator exploitation could have been more profitably employed by confining our efforts to one particular device. We thought to kill two birds with one stone, but the percolator bird got away unscratched.

However, on Jovian Day, Tuesday, September 21, just a few days following the closing of our campaign, the small announcement shown herewith resulted in the sale of 27 percolators and it is possible, of course, that our previous efforts had something to do with the very gratifying sales during the day.



Announcement of a one-day offer which brought fine results.

All old sad irons turned in were placed in the show window, as indicated in the photograph. These attracted considerable attention and favorable comment from passers-by.

Taking into consideration, not only the direct but the indirect results as well, we feel that the outcome of this sale amply justified our efforts. We therefore expect to continue repeating the scheme from year to year unless somebody suggests something better.

Snuggling up to John Smith*

By E. Burt Fenton†

YOU HAVE your list of customers who produce the revenue which keeps the wheels going 'round—but it is plain John Smith, the average citizen of your community who puts bread and butter, coffee and ham-and on your table. It is John Smith who permits you to exist and enjoy such luxuries as your territory affords.

John Smith is not considered here as a customer on your books, but rather as a voting member of the community—and, as such, he is the most important factor with whom you have to deal.

John Smith's other name is "Public Sentiment."

If he is "for" you, your way to continued growth and larger prosperity is comparatively easy. If he is "ferninst" you, there is ambushed trouble ahead of every step you try to take in advance. John Smith *can* make you—and will, if you gain and hold his good will. He can as easily break you, if you grow antagonistic or careless in your attitude toward him.

Surely, so important a factor in your business—so vital an element in your future success—is worth cultivating.

A Lost Good Will and What it Cost

A CITY, favorably located for rapid development, has had its growth retarded and has suffered in many ways because its street railway company has, for a period of years, been unable to secure a franchise under which it could raise funds for needed improvements of a permanent character.

The whole trouble in the city referred to hinges on a good will that was lost nearly two decades ago. It started at a period when John Smith's views were held in lighter esteem than now. Executives then in charge of the company's destinies had not been brought up in the school whose motto is "the public be pleased." They were indifferent to and sometimes contemptuous of John Smith's opinion, and thus they made the opening for certain ambitious politicians to worm their way into popularity, office and power. John Smith got "sore"—and there have been, ever since, plenty of self-interested people ready, willing and anxious to keep him in that frame of mind.

The value of the good will that was lost cannot be measured in dollar marks and figures.

How John Was Won Back

IN ANOTHER city the opposite policy was pursued—and with good effect.

Such troubles as this company had, some years ago, were an inheritance from a past era when "the public be damned" was a recognized utility slogan. Something like a decade and a half ago the property was acquired by men far-seeing enough to know that salvation lay in a change of policy.

All along that line, the new policy of "the public be pleased" was put into operation. The service was improved. Customers

*From the author's paper recently read before the Ohio Electric Association. †Manager Publicity Department, W. S. Barstow and Company.

were given a fair hearing when they came in with complaints. Discriminations were abolished. It came slowly, as these things always do, but in time John Smith's good will was in large measure regained.

Naturally, politicians with ambitions sought popularity by "picking on" the corporation, and there were periods of discouragement when those connected with it wondered whether their efforts to please had been worth while. But the policy was persisted in, quietly and unobtrusively at times—with more display at others.

Finally, it was decided to supplement this work by the use of newspaper space to set forth the aims and hopes and ambitions of the corporation—to "lay all the cards on the table"—as an additional means of clinching the good opinion of Friend John; and the results have more than justified the experiment. He has become the corporation's friend. He feels and knows that his welfare and prosperity are bound up with the company's—that neither can reach the full measure of success without the aid of the other.

In a series of published articles the mystery was taken out of electric service. Many features were explained about which there had been more or less complaint, due to the fact that the people did not understand. Customers were told how to use their service to gain the greatest benefit at the least expense. Everyone was invited to read his own meter, and the company offered to teach those who did not know how. Everything was presented in plain, untechnical language. Complaints were cordially invited; and when they came in, special pains were taken to make clear anything about the service which the customer did not understand. The "rule of courtesy" was enforced in every department.

There is no disposition here to disparage reasonable and seasonable advertising of appliances. John Smith needs to be reminded, occasionally, that an iron or a vacuum cleaner, a toaster, a range or a washing machine will be a good investment. But after all, that important thing you have to sell is *Service,* and the important thing you have to gain and hold is *Good Will.*

Checking Results

THERE IS but one way of checking results of good will advertising. If there is a feeling of dissatisfaction, distrust and unrest among your citizenry—and there is some of this in almost every community—intelligent good will advertising will bring about better feeling, provided it is backed up by performance. You know this, ordinarily, by the dropping off of complaints, and the friendlier expressions you hear from the man on the street.

There is no hard and fast definition of the term "good will," and there is no slide-rule method of checking the results of good-will advertising Anything that will make the John Smith you serve feel more kindly toward you; anything you can do that will accommodate or please him; anything that will prompt him to say to his neighbor, "Well, that was a decent thing for the lighting company to do,"—anything in short that will attract the attention of John Smith, interest him, enlighten him about your business, and prompt him to think better of you, is good-will advertising.

It is not necessarily printed advertising.

The manner of your cashier toward customers when they pay their bills; the attitude of your complaint department toward those who bring in their grievances; the tone of voice you and your employes assume in answering the telephone; the actions of your meter readers, repair men and other employes on the premises of customers; all these little details of the daily routine of business are items of good-will or ill-will advertising, according to the policy you pursue.

When an intending customer calls up by phone and asks you to furnish service, does your clerk answer like this?

"You will *have* to come to the office and sign application."

Or does he politely inform the inquirer that there is a rule of the company requiring an application in writing before service, can be given, with a hint that forms are kept at the office?

Each business must have rules and regulations governing its relations to the public and each company must be governed, in making these rules, by conditions peculiar to its community. As a general thing people are inherently resentful of corporation rules which put them to personal inconvenience. So the greatest care should be taken to make as few such rules as possible and to enforce those that are necessary with the view of reducing irritation to the minimum. In no place does politeness pay so well as in the office of a public utility. John Smith doesn't so much resent complying with a rule, as being told in a cross manner that he must.

Now, John Smith feels just as resentful when you "rub it in" on him with that word "must," or its irritating equivalent "have to." It is just as easy to pass it along politely and painlessly, and John will not only do what you ask, but like you for showing him how.

Keep Your Public Posted

IN PUBLISHED matter, every opportunity should be taken to inform John Smith what his service company is doing and—if it is something likely to be misunderstood—why it is being done. These occurrences generally have a news value and the papers will be glad to publish them as news.

Has a line been extended into new territory? See that the newspapers are informed of the fact. Has there been an accident in which someone was killed or injured? Give out the facts promptly and give them "straight." Take advantage of every possible local event to show the people of your community that your desire is to *serve* them efficiently and constantly.

Add to your good-will advertising, by adopting the policy of sending a friendly personal letter of thanks to each new customer—not a brief, terse business-like letter—a friendly letter, expressing the company's appreciation of the patronage bestowed upon it.

This policy has been found to pay. It changes hostility and indifference to friendliness. John Smith is human. Treat him as a friend and he will be your friend—and you never know at what moment you are going to need his friendship—and need it as badly as one occasionally needed a "gun" in Texas in an earlier and more strenuous day.

There is a distinction between ordinary commercial advertising and good will advertising. Broadly, the difference may be stated thus:

Commercial advertising is the means by which you *sell* something you have—appliances, service, electric current.

Good will advertising is the effort to *acquire* something—the friendly interest of your community in your welfare and its own. It is the effort to gain John Smith's good will—the most valuable asset you can have. In proportion as your case is intelligently and tactfully presented to Smith, your efforts in this direction will be successful.

Place of Publicity Department

YOUR publicity department should take rank with your operating, engineering, treasury and accounting departments. You need John Smith's good will before you can get his dollars. It is just as important that you have this asset, as that you have a plant and transmission system; that you operate it efficiently and economically; that you have a custodian of your funds and that they are properly accounted for. Publicity is not a side issue. It is a vital factor in your development and your permanent prosperity.

John Smith is your meal ticket.

Snuggle up to him as you would to a wealthy bachelor uncle. Get on his "good side" and stay there Go out of your way to make him like you. It will pay in big, round dollars. It will pay in contentment and peace of mind. Above all, it will pay because, after you have made him your friend, you will discover that his good will is not only the most profitable, but the most enjoyable of your assets.

How Can Gas and Electric Companies Render the Best Lighting Service

*By A. B. Spaulding and N. H. Potter**

ONE OF the important subjects to-day among combined gas and electric companies is "How can the best service be given?" The engineering phases of this question have received marked attention, and the improvement in design and operation of gas and electric plants has increased the confidence of the public in the efficiency of these plants.

This paper deals with the rendering of service after the product is delivered, or beyond the meter. There are differences of opinion as to how this can be done.

Among the trio of products of gas and electric companies—light, heat and power—light has always received the first place. Upon the selling of this product depended the initial success of all gas and electric companies; and the early history of both industries is bound up inseparably with the development of their lighting business.

There has been a radical change in the methods and personnel of the selling force. Heretofore gas and electric energy were the points of discussion with the consumer; but now illumination is the topic. Instead of so many cubic feet of gas or watts of energy, illumination is being sold.

Selling and service should be synonymous, and service has various phases. In order to render it intelligently it is essential, fiist, that the representative be capable of laying out and supervising a lighting installation; second, that the consumer be educated to appreciate the difference between proper and improper lighting, insofar as the value of proper lighting to his business is concerned.

Service does not necessarily mean the reduction of bills; it may and often does result in an increase in the amount of business with customers. Proper illumination is desired and must be the primary factor in the discussion of cost, not only of electricity and gas supplied, but of fixtures and first installation. Service, therefore, means the providing of the illumination best suited to each customer at minimum cos\

Both the representative of lighting companies and the public must be educated to the value, use and maintenance of a lighting installation.

Illumination Specialists.

THE WRITERS believe that with gas and electric companies under one management, specialists on gas illumination and specialists on electric illumination are productive of the best results, particularly as regards service to the customer This method is in reality intensive selling and each man becomes an expert in either gas or electric illumination Both men are selling the same thing, illumination; and unconsciously perhaps, each man picks out the most likely prospects.

It would seem that there is no good reason for a gas or electric company under one management adopting a policy which encourages any one source of supply. The duty of such a company is not to pre-determine what service to sell, but to give the customer the benefit of the best advice and leave to him the decision.

That two sources are better than one is certain where gas and electric units are installed for general illumination. The units should, of course, harmonize with each other and with their surroundings. The only question, which might influence the installation of a single source, would be its adaptability.

The argument that has been advanced is that by having one man sell both gas and electric illumination, the selling force could be cut in half. This is not true if the business is to be taken care of properly.

It has been contended that the cousumer is confused by having two men advising different sources of supply. This may be true where companies are under seperate management if competition dictates a policy of "Get business anyway—but get it," rather than a policy of real service to the consumer. With a company under one management the consumer is not confused by having information on both gas and electric illumination from different men.

The customer should be credited with common sense and have the privilege of choice. By having both sides advanced to him by experts he is able to consider economy, convenience, safety, etc., and in the end be sure that he is getting that method of illumination best suited to his needs.

Summing up the case one finds that seperate gas and electric lighting representatives are in the end no more expensive than combination representatives. Thre is absolutely no question that this seperation does stimulate the trade in a healthy manner. Each salesman becomes more proficient in the art of gas or electric illumination as the case may be. He has co-operative competition and will necessarily have to watch his installations more closely. He is also forced to take the proper installations, to render proper service after the installation is made and to keep in close touch with improvements in his particular line; otherwise he is likely to have "lost business" charged up against him.

A man selling both gas and electricity is too prone to follow the path of least resistance and to think, "If I don't sell gas, I will sell electricity," with the result that a desire for better illumination is not created and therefore the best service is not given.

Lighting representatives should have a good appearance, personality, and selling ability, together with a knowledge of the principles of illumination. The salesman should make a general survey of his territory and become familiar with its conditions. He should make periodic tours after dark in the store section. He can then pick out the improperly lighted stores and by one night's work of this sort obtain sufficient leads to keep him busy for several days. The writers know of several instances where salesmen living out of town have never seen their territory illuminated. After making night inspections and following up leads thus obtained, the volume of store business from their particular sections showed a marked increase, and improved installations also resulted.

The representative should visit other districts than his own and, where possible, other cities and towns, thus acquainting himself with conditions, perhaps different than those in his territory which will enable him to handle more successfully new and similar problems as they rise.

The lighting representative should, if he expects to become more valuable to his company, do everything in his power to increase his knowledge of illumination and other branches of the business. This can be realized by becoming a member in the various associations and in this way obtain at first hand, knowledge of all advancements in the art of illumination as well as other subjects. There are other means at hand of increasing one's knowledge and keeping abreast of the times; reading periodicals dealing with all branches of illumination and advertising literature sent out by manufacturers, which contains an education in itself. This literature should be studied, not merely read; for here is a fruitful field of knowledge. Up-to-

*From the authors' paper presented at the ninth annual convention of Illuminating Engineering Society.

date data can be obtained by having one's name placed on the mailing lists of manufacturers.

The sales manager in charge of these men should hold regular meetings for the discussion of illuminating problems. Arrangement should be made for visits to places like testing laboratories, various fixture shops and lamp works. When some particularly fine installation has been made in the vicinity a party should be made up to inspect and discuss it when it is lighted.

The company itself has a duty to perform in the education of its representatives. It should encourage the men to study and show that their efforts are appreciated.

Educating The Customer

THE MAIN object of a storekeeper is to sell merchandise; he has no desire to become an illuminating engineer; but he is desirous of having his store and window properly illuminated, provided of course, he is an up-to-date merchant. In the event of his being behind the times—and there are many of that kind—in fact, they are the ones who make up the best list of prospects—he should be taught that a properly lighted store and window is absolutely necessary for success in selling merchandise.

The desire to have a properly lighted window, store, factory or home lies dormant in every man, and under stimulus he will unconsciously start a course of self-education by asking questions and observing other installations and perhaps by reading.

The company should send advertising literature acquainting him with the proper methods of using lighting units. For obvious reasons this literature should be absolutely non-technical. It should be snappy in appearance and so written that it will hold the attention from cover to cover.

The manufacturer's representative should present the subject of illumination first, and, secondly, the wares he is selling. The architect, builder, electrician and gas fitter should be educated by both the company and the manufacturer in order that they may in turn do their part toward the education of the prospective customer.

With these three different sources of information for the customer properly co-ordinated, there would be little or no reason for the absence of good lighting installations.

Public Relations

THE FIRST consideration in this relation is the impressing upon the customer the value of proper illumination. Poor installations have been made in every town and one of the present difficulties is to have the customer realize the importance of a good installation.

If the manufacturer of lamps and accessories were to deal entirely through the gas and electric company whose sole idea is proper illumination, or at least submit for the approval of these companies the unit or accessory which is to be installed for a customer, relations with the consumer would be much improved.

Cheap and inefficient gas and electric units have caused the gas and electric companies much trouble. Such units are often sold with an argument to the effect that the gas or electric company is robbing the consumer and will not sell units because they reduce the company's revenue.

On account of such conflicting suggestions to the customer it has been found advisable to demonstrate the correctness of recommendations made. The Public Service Electric Company of New Jersey has been using for some time very successfully window demonstration sets. These are made up in portable form and consist of 4-ft. sections of pipe with five outlets. Twenty-five 40 or 60-watt lamps with proper reflectors may be connected and in case of large windows several sets may be hung in line. The sets are hung by the representative in a few minutes by the use of a few screw eyes and picture wire, and connections made by lamp cord to any available lamp socket. As may be seen the outfit is very flexible and may be made to fit any window condition. It may be advisable to change these outfits to accommodate the gas filled lamp on account of its better color value and increased efficiency. The demonstration not only shows the display to better advantage, but the merchant gives more attention to the dressing of his windows, which, combined with good lighting, results in increased sales of his merchandise, thereby bringing the company and customer closer together, the latter realizing that the company has rendered real service.

By advising customers both as to lighting and dressing of their windows, it has been possible to have more light used not only for illumination, but as part of merchandise displays. For instance, a customer who operates a piano store desired a special dressing for his window and the display installed was a reproduction of a painting entitled "Just a Song at Twilight." A reproduction of the original painting was placed in the window and properly lighted. In one corner of the window was a woman playing a baby grand piano and on the other side a fireplace, in front of which the husband sat holding a child in his arms. At one side of the room was a window through which was projected the proper effect. Alternately the lighting of the window itself was flashed on.

Since the installation of this window the electric company has been requested many times to dress other windows, and in every case where this has been done, the number of observers of the window has been more than doubled, and in the case of the window mentioned the observers were increased 1,200 percent between 5 and 11 o'clock at night.

These installations, which are allowed to remain about a week, usually convince customers of their value and lead to the installation of permanent outfits.

Factory lighting may be handled in the same way. Demonstrations of either gas or electric lighting has been in many cases the closing argument for the sale of better lighting. After the installation is laid out, it is necessary that the representative should closely follow the development in the work to see that the suggestions of the electrician or plumber are not such as to spoil the desired results. It has often occurred that the customer accepting advice on changes in position of outlets and accessories secures an incorrect installation and blames the representative for whatever unsatisfactory result may ensue.

The representative's responsibility does not end with the demonstration. It is his duty to lay out the proper units, supervising their installation and see that prompt service is rendered.

At this point the real service in lighting installations begins. Once connected to the company's supply, service to the customer never ends, and that all important question of maintenance begins.

In the case of electric lighting, maintenance is more or less a matter of education. The customer should be taught first that electric lamps have a useful life and that after a certain period it is economy to throw away the old and purchase new lamps. Secondly, reflectors decrease in efficiency with the accumulation of dust, and like the plate glass window in the store must be cleaned periodically.

The customer usually promises to attend to these details which is in reality a part of his regular house cleaning, but the drop in efficiency or the loss in illumination is by such small steps, that it is never noticeable from day to day, and the consumer being intent on selling goods, gives little or no attention to the importance of maintenance.

The lighting salesman may continue rendering service by calling attention to any blackened lamps, dirty reflectors, etc. By stating to the customer that this is his (the salesman's) installation, that he is proud of it, but that it cannot come up to his guarantee unless properly cared for, the customer is usually awakened to his responsibility in the matter and the habit of periodic inspection and cleaning is formed.

In the case of a gas installation, maintenance is also a very important matter. Thoughtlessness or carelessness is the reason for depreciation in lighting value. Again the daily change or drop in efficiency is so small as to be unnoticeable. Many customers through not having time or not appreciating this drop

in efficiency continue using old or broken mantles with the result that very poor service is obtained from the unit.

Gas companies have been trying for years to educate customers to give proper attention to their lighting units, but in many cases it is almost a hopeless task, with the result that in many instances companies have launched maintenance departments to do for the customers what he does not seem to care to do for himself. Probably the day is not far off when all gas companies will have to maintain all customer's lighting installations in order to insure proper illumination.

It is the opinion of the writers that a combined gas and electric company, under one management, may give the best lighting service by employing seperate representatives who are specialists in the application of each lighting source. These representatives should be encouraged to keep in touch with the science of illuminating engineering and the most advanced thought in modern salesmanship. The company should lead the customer to an intelligent appreciation of proper illumination and by the adoption of maintenance service, should make him feel that the company is genuinely interested in his continued satisfaction.

❖ ❖ ❖

Two Successful Sales Methods

BY GETTING together a number of young men some of them high school boys, and paying them a reasonable commission on their sales, the Birmingham (Ala.) Railway, Light and Power Company, was able to dispose of 520 electric irons and 235 miscellaneous appliances. Frank Hammond, commercial manager of the company in giving this information, advises that these were the results of the July heating appliance campaign.

The young men or salesmen as they should be called, were sent out through the city in sets, two to the set with one small boy to drive the wagon which was loaded with electrical appliances. Each man worked one side of the street, canvassing from house to house.

An advertisement run by the Birmingham Railway, Light and Power Company, during its campaign.

Full instructions were given each salesman on the proper way to present the appliance to the housewife, as well as the best talking points in connection with good salesmanship. This whirlwind campaign was followed by another house to house canvass and splendid results gotten from this. The sales up to date have kept up very satisfactorily.

Following up these splendid results, a flat iron campaign was waged during the month of September. The reproduction of a newspaper advertisment herewith tells the story. It should be added, however, that a credit of 71 cents was allowed on all old style sad irons when an electric iron was purchased. The show window of the company was well utilized in this connection.

In one window were arranged, 500 electric irons and in the other a place was reserved for old sad irons. This old sad iron window was draped in black showing the death of the old sad iron. A card was placed in the window to show how fast the electric irons were going and how rapidly the other window was filling up.

The results were fine and much interest was manifested by prospective users of electric irons.

❖ ❖ ❖

Marketing the Electric Vehicle

EXCELLENT success has been achieved in the special sales campaign carried out during October in behalf of the Ward Special, a 750-pound capacity electric delivery wagon. This campaign and the special offer made with it was restricted to Greater New York, nearby New Jersey, Long Island and Westchester County

A Ward Special from New York enroute to Cleveland.—Note the muddy road this vehicle is passing over. The 734-mile run was covered in 11 days on 1064-amp-hr. without a mishap.

There are a number of special features connected with this campaign. The work is jointly shared by the manufacturers and the electric light and power companies operating in the territory covered. The vehicle in whose interests it is conducted, is the first low-priced electric placed on the market. The price, $875, includes a year's rental of the Edison storage battery. The rental charge for the battery after the first year will be $10.50 a month with an additional charge of 1¾ cents a mile, for monthly mileage in excess of 625. Another feature is the arrangement for time-payments.

This campaign is especially directed toward the neighborhood merchant, who uses one, or perhaps two horses with an occasional need for another. Cost data has been carefully prepared and presented. For instance, it is shown that there are 50 stables in New York where one of these electrics can be stored and washed for $10 a month. The cost for current, for more than the distance that a horse delivery wagon makes each day unless under favorable conditions, would be another $10. Against this is the cost of $28 or $30 a month for stabling and feeding a horse. The cost of tires just about equals the cost of shoeing a horse.

New Products And How to Use Them

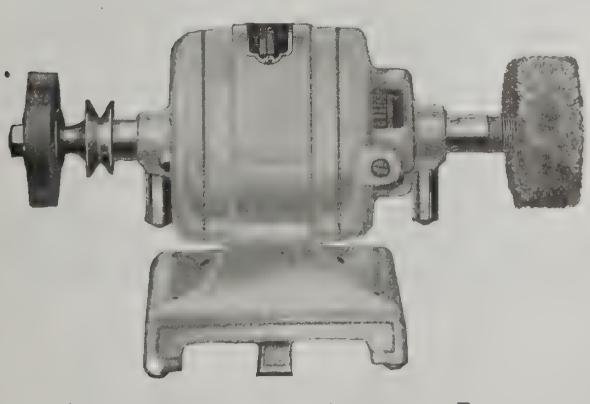
A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

Fractional Horse Power Motors

THE EXTENSIVE line of small Universal Dumore motors has been increased recently by the development of a new sewing-machine motor. This and other fractional horse-power motors are manufactured by the Wisconsin Electric Company, of Racine, Wis.

UNIVERSAL SEWING-MACHINE MOTOR.—WISCONSIN ELECTRIC COMPANY, 1300 DUMORE BLDG., RACINE, WIS.

As shown by the illustration: the motor may be attached to any kind of sewing-machine without the use of clamps or screws, by merely placing under the hand-wheel. No change in the machine proper is required when changing to this motor drive, it is only necessary to slip the old belt off the flywheel.



1/8-HP. UNIVERSAL MOTOR BUFFER AND POLISHER

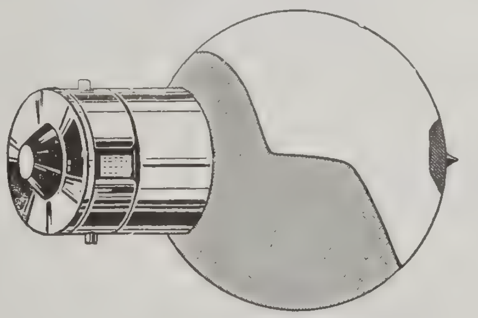
The motor operates on either a. c. or d. c. circuits by attaching to any electric light socket. In operation it consumes about one-cent worth of current. A treadle-operated controller regulates the speed. In this way the machine is under control at all times and a slight pressure of the foot will give any desired speed up to 800 stitches per minute.

Another application of the Dumore type motor is for buffing and polishing such as required by jewelers and dentists. In the illustration herewith is shown a black-enameled 1/8-hp. motor for this purpose. It is arranged for rheostat control and may be had in speeds of 2000, 4000 or 6000 r. p. m.

In the construction of the motors made by the Wisconsin Electric, special attention has been given to the vital parts, such as the armatures, fields, bearings, etc. The oiling system employed on each particular motor is that which is best suited to it. With reasonable care no bearing or lubricating trouble will be experienced.

Non-Glaring Headlight Lamp

THE illustration herewith shows the Mac Kno-Glare (swivel bulb) Auto Lamp. It embodies not only a new principle of controlling electrically equipped headlights for eliminating all dazzle, and glare, but the base itself is said to be the only improvement made in Ediswan miniature lamp bases for many years. As will be noted, a portion of the lamp bulb is treated with a semi-translucent compound. This compound is placed upon the bulb in a peculiar form, and in certain proportions. The new base is standard, and will fit into Ediswan sockets of



A NON-GLARING LAMP FOR HEADLIGHTS.—A. HALL BERRY, 99 WARREN STREET, NEW YORK.

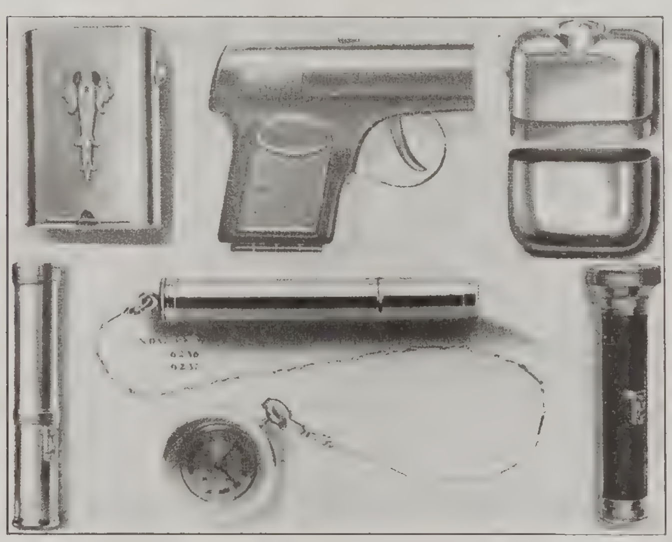
any make. However, the pins which hold the lamp in the socket, are mounted upon a separate ring which fits into a recessed portion of the lamp base. The lamp is installed identically the same as any other lamp, but when locked in the socket, the lamp may then be rotated to bring the treated portion of the bulb at the bottom part of the reflector, this being done without in any manner necessitating the changing of the position of the socket, regardless of the year or make of car.

These lamps are made in all candle powers and voltages, in both single and double contact. The manufacturers claim to have the only device on the market which eliminates all dazzle and glare, but does not decrease the driving light. The entire sales are controlled by A. Hall Berry, of 99 Warren street, New York.

Practical Flashlight Novelties

THIS IS the holiday season, the time of gift giving. Dealers therefore, should not lose sight of the fact that flashlights, especially in the form of practical novelities, are quick sellers. In the illustrations herewith, are shown several of the Kwik-lite products as made by The Usona Manufacturing Co., Inc., 1 Hudson Street, New York, and of Toledo, Ohio. These are not mere novelties, but practical convenient flashlights, some of which are entirely new and others represent considerable improvement.

The tubular flashlight shown attached to a watch chain is no larger than a fountain pen and looks like the ordinary silver clutch pencil, the metal case of which is made in five finishes as described below. The switch is on the top cap and has a small metal ring or link attached, so that if desired, the device can be clasped to a watch or vest pocket chain. However, the flashlight is so small and weighs so little that it can be carried anywhere.



SOME OF THE KWIK-LITE FLASHLIGHT NOVELTIES

The vestpocket flashlight shown partly disassembled, is made of metal in five different finishes. No hinges or clasps are used in its construction, the telescope principle being resorted to. The case consists of two parts drawn into shape from a solid sheet of metal, the lower part telescoping over the upper part and when pushed together they firmly lock. With a slight pressure

THE KWIK-LITE IVORY AND GOLD FLASHLIGHT.—THE USONA MANUFACTURING CO., INC., 1 HUDSON ST., N. Y., AND ST. CLAIR STREET, TOLEDO, O.

on the side of the case, the two pieces can be pulled apart, making it an easy matter to insert the battery. The metal tubular flash light shown, is strong and sturdy. These are also drawn from a solid sheet of brass, the two parts telescoping near the center, being securely joined by means of cut threads. The lens is secured by a separate screw end ring. This allows a broken lens to be replaced without securing an entire new head. These flashlights are made in the five finishes above referred to namely—nickel plating, gun-metal, statuary bronze and matt gold. Tubular flashlights are also made of fiber and finished in black with nickel-plated trimmings as shown.

To meet the demand for an artistic tubular flashlight, the ivory and gold device has been placed on the market. In appearance as may be seen in the illustration, these are more refined than ordinary types, and they harmonize with the usual interior decorations, thus finding a place on the bedroom dresser or library table. The body of the case is made of Parisian ivory, treated so that it will not crack, and the trimmings are of 14 carat gold. A name-plate on one side provides for a monogram or inscription, which greatly adds to the gift giving value of the flashlight.

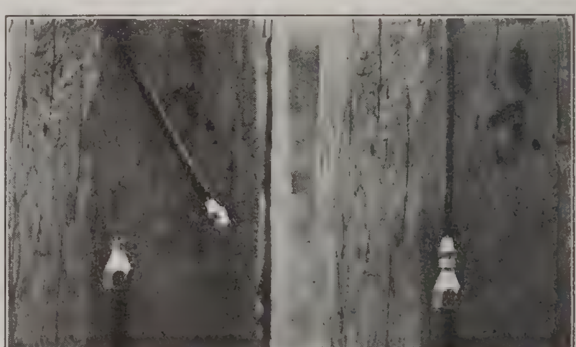
THE KWIK-LITE HEAD LIGHT ATTACHED TO A BICYCLE.

A particularly noteworthy device, is the new electric headlight designed for use on various types of vehicles. Its aplication to a bicycle is shown in the illustration. The headlight is detachable and requires but one standard dry cell for operation. It can be adjusted so that the ray of light can be thrown on the ground directly in front, to cast a broad circle of light right in front of the wheel or at any angle desired. By means of the lamp and the parabolic reflector used, the light can be thrown a distance of 100 feet.

Some of the other Kwik-lite specialties include various types of electric hand lanterns, bullet flashlights together with the lamps and batteries required for these appliances.

Ground Connection

A PERFECT device for ground connection is the appliance engineers have been seeking a long time. It is claimed by the makers that the new type A device, as illustrated, fulfills this demand; it is a new product of the Fargo Manufacturing Co., Poughkeepsie, N. Y. With this device a positive contact and ground, or as near positive as can be made by mechanical means,

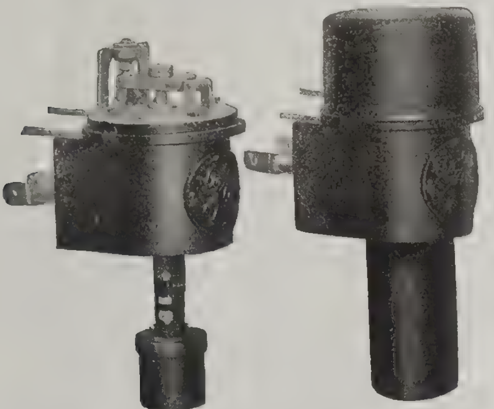


GROUND CONNECTION; OPEN AND CLOSED.—FARGO MANUFACTURING COMPANY, INC., POUGHKEEPSIE, N. Y.

is possible. It is stated that the usual trouble from poor contacts has been eliminated by the type of connection used; this practically welds the ground wire or cable to the ground point, which is in the permanent damp earth. No solder, bolts or set screws are used for connection on this Fargo device—the compression feature is resorted to. Such connections have stood a strain test up to 40 000 lbs. per square inch before the grip would let go

Compensator Relay and New Pole-line Switch

A NEW type of circuit-opening inverse time limit oil dashpot relay has recently been developed by the General Electric Company of Schenectady, New York, for use in conjunction with a low voltage release for automatic, overload and low-voltage protection of alternating current motors up to 2,500 volts and 300 amp.



COMPENSATOR TYPE RELAY.—GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

The relay is connected in series with the line, the low voltage release across one phase in the usual manner with the low voltage coil in series with the relay contacts.

On overload greater than the current setting of the relay, the relay contacts open-circuit the low voltage release coil and the motor is cut out of circuit. If the voltage drops to predetermined percent of normal, the motor is also disconnected from the power supply.

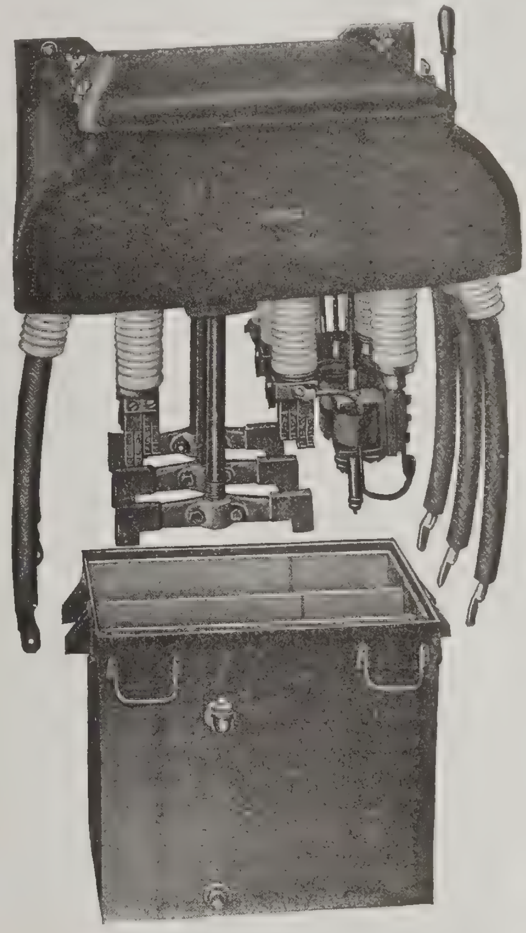
This relay is mostly employed with motors using self-contained compensator control, but sometimes for switchboard service when both low voltage and time delay overload protection are required. Here series relays replace the secondary relays, current transformers and oil switch tripping coils otherwise required.

The new relay is a vast improvement over the one previously manufactured. The contact, dashpot and calibrating tube are inclosed by dust-proof stamped steel covers. Current and time adjustment are accomplished outside of the dashpot simply with the aid of a screw driver. The settings are constant, for an adjusting nut is locked in place after each setting is made.

Another recent product of this company is a pole-line oil switch which automatically opens the circuit in which the switch is connected if the current in that circuit exceeds a certain definite amount for which the tripping mechanism is set. In many cases the use of this switch in connection with pole type transformers obviates the necessity of bringing high-tension lines into a building. The switch is closed by a handle affixed to the frame. The automatic operation on overload is affected by tripping coils in series with the line. These coils are located in the oil vessel under oil and are connected to a common tripping lever by separate wooden rods. The tripping device may be actuated by any one of the overload trip coils, or by a hand operated triprod—not visible, but outside the switch frame. The switch can not be opened by the closing handle. An inverse-time oil-dashpot of the type illustrated, when connected to the tripping device affords a time delay in automatic tripping.

Insulated cables enter the switch from below through porcelain bushings in an overhang on the switch frame. The space between cables and these bushings, as well as other bushings through which the cables partly run, is filled with insulating compound. There are no uninsulated parts within the switch frame.

The oil vessel has an insulating lining, wooden barriers between poles and between trip coils, drain cock and filling tap so that the oil may be changed without lowering the vessel, and handles to assist in handling the switch or in removing the vessel for inspection of the contacts, which are of the sliding wedge type of construction. This switch is thoroughly weather-proof.



GENERAL ELECTRIC AUTOMATIC POLE LINE SWITCH WITH 3-COIL SERIES TIME-LIMIT TRIP.

With the exception of the operating lever and hand tripping rod, all parts are enclosed and protected from the weather. The cover is grooved on the under side to fit closely over the edge of the frame. The oil vessel fits around a flange on the bottom of the frame.

This switch can be obtained single, double, triple or four-pole, single throw, for use up to 15,000 volts and 300 amperes.

❖ ❖ ❖

Household Appliances

Until quite recent years, "things to give" for the most part have been "little nothings"—usually worthless other than to produce a momentary thrill but soon to be laid away and in a short while both giver and gift forgotten. But at this time along with the gift spirit comes the thrift spirit. And gifts of real utility are the vogue. Electrical appliances are certainly in this class.

The Hotpoint Electric Heating Company of Ontario, California, in following the above thoughts, have recently produced the Hotpoint Boudoir Set—a dainty, useful electrical appliance for miladi's boudoir.

This set may be operated from any lamp-socket and consists of a 3-pound electric iron with beveled edge sole-plate permitting the operator to iron under and between ruffles, plaits, and tucks; an inverting stand to convert the electric iron into a

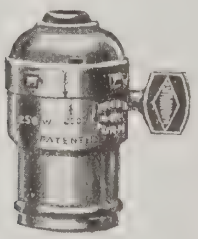
small electric stove for light cooking or heating and boiling small quantities of liquid; and a hood, or soleplate cover which is placed over the sole-plate of the inverted iron and forms a receptacle for heating two curling-tongs, or a marcel-waver; a pair of folding curling-tongs, and cord with small switch-plug interchangeable with other Hotpoint appliances such as El Boilo, Safety Comfos and 4-in. El Stovos. The entire outfit telescopes and fits into a neat brown felt bag.

Boudoir Set.—Hotpoint Electric Heating Company, Ontario, Cal.

The outfit is tastefully designed and finished in highly polished nickel. And from all reports it ought indeed be a welcome gift to grace the dressing-table of the most elaborate as well as the simple and plain boudoir. Exceptionally desirable for the traveler—it takes up very little room in traveling-bag or suit-case. The complete set is popularly priced, $4.00 and the iron alone $3.00.

A New Key-Socket

BY PLACING their new key-socket on the market, of the type illustrated herewith, W. R. Ostrander and Company of 22 Dey Street, New York, have completed the socket lines as planned by them. All their sockets are equipped with the Ostrander locking device, which is a mechanism of loops and tongues, forming a contact so rigid that the socket shell will bear a permanent shade weight of over 50 lbs. The key of the key-socket is supported by a brass loop, and will operate 150 percent more times than required. As in the keyless socket, the porcelain member is a solid piece, as is the insulating fibre. This latter feature reduces the possibility of short-circuit.



New Key-Socket. — W. R. Ostrander and Company, 22 Dey Street, New York.

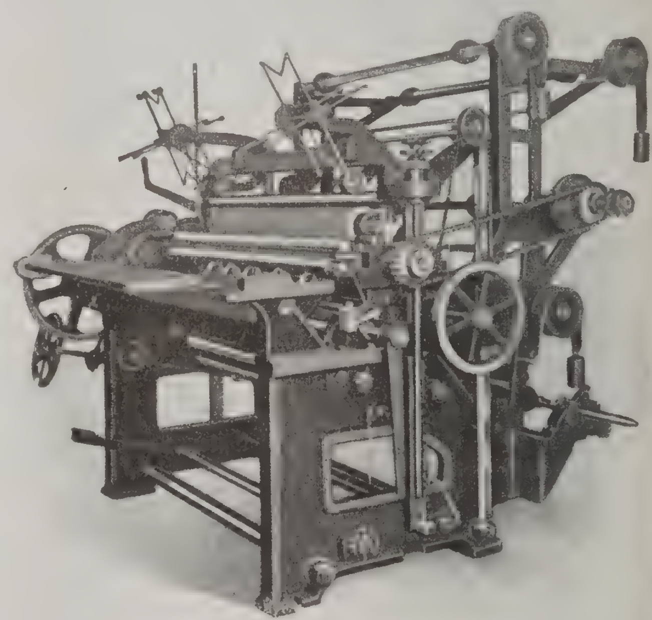
The pull-chain socket made by this company is claimed to be the only one in which the chain proper is not individually insulated. In this socket the chain touches no current carrying member, thus eliminating all chance of shock and accident.

These sockets carry more current than is specified by the underwriters, and the curved end of contact members retain loose cord strands and greatly assist in wiring. The wiring points are provided with large head and upset screws so as to further assist the wireman. A double make-and-break mechanism takes up maximum overloads. The Ostrander sockets are marketed in standard packages of 250, which reduces by half, the present quantity necessary to secure the package price.

Slitting and Coiling Machine

A MACHINE that is useful to manufacturers of mechanical rubber goods, such as insulating tape and rubber belting, is illustrated herewith. It is made by the Cameron Machine Company at 57 Poplar Street, Brooklyn, N. Y. An ideal machine for the above purposes should have a simple and durable mechanism and be easy to operate. It should be adjustable quickly and accurately for any change of widths required. It should be possible to guide the material accurately so that there be a minimum of waste if any, on the selvage edge. The machine should be equipped to measure the yardage accurately as a check on waste and loss. The same machine should be able to operate on any and every kind of fabric, paper and other material, and produce any width of strip required in any size of coil. The machine should produce firm rolls, even as to edges, and of uniform tension without actually stretching the goods. The machine should be fool-proof both ways so that the operator cannot hurt it, or be hurt by it.

It is claimed that specications as broad and inclusive as the foregoing, give a true description of the Cameron Machine, as it is the result of seventeen years of experience devoted exclusively to the making of cutting mechanism of all kinds.



New Slitting and Coiling Machine.—Cameron Machine Company, 57 Poplar Street, Brooklyn, N. Y.

The principle of slitting embodied in this apparatus has no limit as to speed. The edge of the slitter wheels requires very little attention. The edge is not maintained sharp and keen, but rather resembles that of a cold chisel, which is slightly blunt. The operator takes entire charge of the machine, and also keeps the slitter wheel in good order. Possibly an hour per week covers all maintenance work. The surface of the cutter roll is not in any way affected by the slitter wheels, as it is impossible to destroy the surface of the cutter roll, or to mar it with grooves. Modern requirements in the manufacture of steel, have made this result possible.

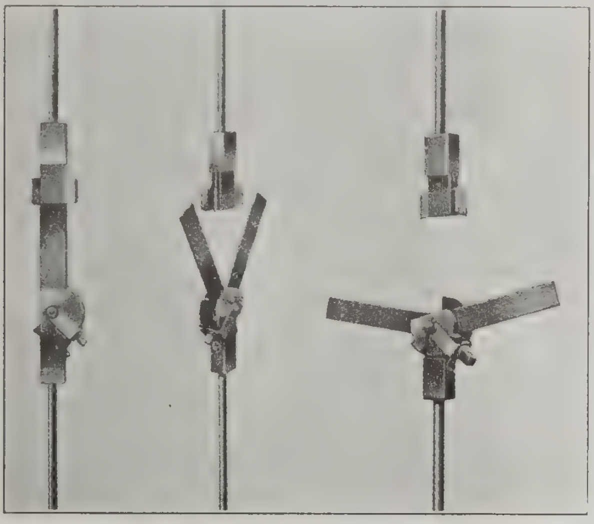
The rewinding apparatus which rolls up the goods following the slitting, is of the drum or surface-rewind type. The apparatus consists of supporting rolls of which the cutter roll is one, together with riding roll, which presses upon the upper surface of the coils and holds them in uniform contact with the supporting rolls. By revolving at a higher rate of speed the rolls are wound up firmly and snugly, thereby producing a very firm compact coil without stretching the web. The supporting rolls are spaced close together and rotate in the same direction, so that the coils resting on them will be caused to rotate at a uniform surface speed with the cutting.

In the unwinding of the coils produced by the Cameron method there is no tendency whatever for the threads to become entangled and unravel at the edges. This fact is of prime importance on cable winding strip of all kinds and on insulating strip sold to the trade. The old method of producing such strip

by slicing off coils from a roll revolved on a spindle tends to mesh the edges of one strip into the edge of the neighboring strip and to cause considerable fraying in the unwinding.

Balanced Disconnect Switch

IN THE illustration below may be seen a form of disconnect switch which is a radical departure from the principles used in the ordinary knife disconnect. It is known as the Minerallac Balanced disconnect switch and is manufactured by the Minerallac Electric Co., Chicago, Ill. Due to its construction it eliminates the necessity for expensive frame work insulators and



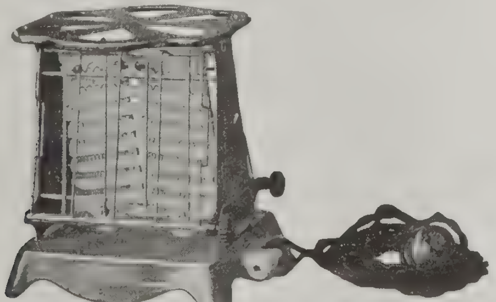
OPERATION OF BALANCED DISCONNECT SWITCH.—MINERRALLAC ELECTRIC COMPANY, 400 S. HAYNE AVE., CHICAGO, ILL.

additional copper and offers proper protection for the operator. Some of the features claimed for this new type of disconnect is: absolute disconnection as there is no convenient insulating base to shunt the gap made by the open blades; torsional operation; self locking feature which automatically locks the switch in any position.

New Heating Devices

A RECENT addition to the line of electric ware marketed by the Westinghouse Electric & Mfg. Company, of East Pittsburgh, Pa., is the Turnover Toaster. The appearance of this device is shown in the accompanying illustration.

By turning the knob near the bottom, the frame is thrown outward, while wire catches at the bottom, trip the toast outward so that it slides along the frame, browned side down.



A NEW TURNOVER TOASTER.—WESTINGHOUSE ELECTRIC AND MFG. CO., EAST PITTSBURGH, PA.

On turning the knob back again the toast is raised to a vertical position with the fresh side toward the heater.

The heating element consists of a continuous coil of resistance wire wound on a porcelain plate. The resistance is so distributed as to produce uniform heating, taking into account the variation in heating effect caused by the vertical position of the heater.

The entire device is nickel-plated, highly polished, and has a shelf for warming plates or keeping the toast or the coffee hot.

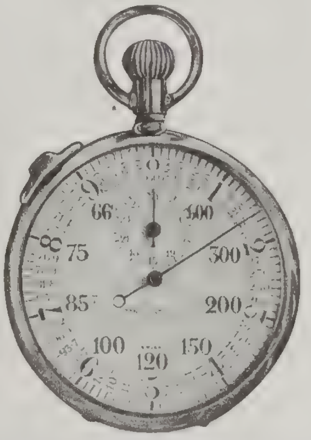
Other recent additions made by this company are Electric Hot Plates for hotel, restaurant and domestic use. It is claimed that no special utensils are needed with hot plates as they have radiant heaters with all the heat at the top and are very efficient with ordinary cooking vessels. The hot plates are made in 8-in. and 10-in. sizes and in combination. The 8-in. heater switches have four positions—high heat, medium heat, low heat, and off. No current is wasted at any heat, the connections being such as to utilize all the current consumed and to produce uniform heating. In the 10-in. heater, three separate switches are used by means of which an area of six, eight or ten inches in diameter may be illuminated.

Non-corrosive material is used for the heating elements. Water or food spilled over the heater will not damage it. The porcelain brick on which the heating element is assembled will stand rough usage. Deflector plates below the heaters prevent scorching the table, protect the connections, and increase the efficiency of the heater.

Time Study Watch

BECAUSE the ordinary stop and decimal-dial watches are not satisfactory for keeping a proper line on the output of a factory, the Time Study Watch with its computed dial was brought out by M. J. Silberberg of Chicago, Ill., to meet the requirements of all factory users.

For the professional rate setter it is his regular decimal-dial, with take-out-time feature and stem actuated set back and does everything that any other watch ever made for the purpose can do.



A DIRECT READING TIME STUDY WATCH—M. J. SILBERBERG, PEOPLES' GAS BUILDING, CHICAGO, ILL.

Its dial is divided in tenths and hundredths of minutes and it is of a convenient and neat size for his use. In addition to these desirable features the dial contains figures spaced two hundredths of a minute apart and distinctly legible that indicate at any point of elapsed time exactly what the corresponding output per hour is.

The convenience of this can only be appreciated by using the watch. Such work as punch press, printing press, drop hammer, forging, screw machine, small milling and profiling, box making, time and motion study, lost motion, determination, general cost data, rate standardization, labor costs, general machine production, furniture factory, clerical, and all other short time operations give an instant proof of its value.

Electrical Soldering Iron

THE illustration herewith shows the new Monarch soldering iron in use. It is manufactured by the Monarch Refillable Fuse Co., of Buffalo, N. Y. The object of the electrical soldering iron is to form or generate heat at the point of contact and directly at the spot where the heat is needed for soldering purposes, whether it be electric wires, armatures or cable work. This soldering iron with its high resistance points works in conjunction with a small transformer which is made in various styles to suit the work in hand. The instant the object to be soldered bridges the heating points the iron immediately becomes hot; the moment the tool is taken from the work the current ceases to flow as the circuit between the points of resistance is open. This feature makes the soldering iron not only an economical tool as far as current consumption is concerned, but it also saves time. The manufacturers are at present working on a new factory for the sole purpose of making this new iron.

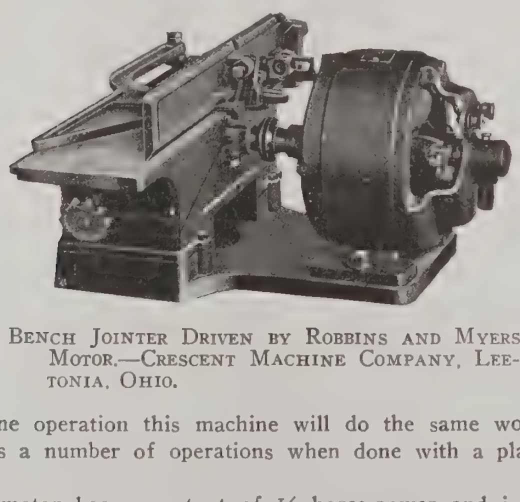
APPLICATION OF THE ELECTRIC SOLDERING IRON—MONARCH REFILLABLE FUSE CO., 148 JEFFERSON ST., BUFFALO, N. Y.

✤ ✤ ✤

Electric Bench Jointer

THE illustration herewith shows a small four-inch electric jointer developed to do such jobs as are ordinarily done by hand with a plane and square. It is manufactured by the Crescent Machine Company, of Leetonia, Ohio. The machine is furnished with a round safety head, tilting bench for level work, automatic guard and rear table for rabbetting.

The jointer and motor are direct-connected and are mounted on a common sub-base. The knives are four inches long and the over-all dimensions of the machine are 20 by 18 by 9 in. high. The net weight is 90 pounds.



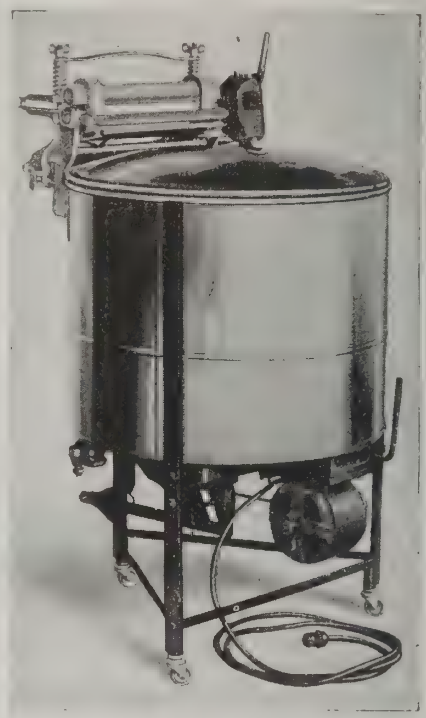
BENCH JOINTER DRIVEN BY ROBBINS AND MYERS MOTOR.—CRESCENT MACHINE COMPANY, LEETONIA, OHIO.

In one operation this machine will do the same work that requires a number of operations when done with a plane and square.

The motor has an output of ¼ horse-power and is of the Robbins and Myers make.

A New Principle Washer

THE electrically-operated washer shown in the illustration and manufactured by the Frantz Premier Company of New York, makes use of the suction and compression principle so that rubbing is entirely eliminated and wear and tear on the clothes is reduced to a minimum. Two vacuum plungers move up and down inside the tub at the rate of sixty times a minute, revolving above the water thus reaching all parts of the tub. On the down stroke of the plunger air is compressed and forces the soapy water through the mesh of the fabric, while on the up stroke the plunger reverses the operation, sucking the water through the mesh and carrying with it all dirt and foreign substances.



ELECTRIC WASHER EQUIPPED WITH WESTINGHOUSE MOTOR—FRANTZ-PREMIER CO., 47 WEST 34TH ST., NEW YORK.

The washer and wringer are operated by a Westinghouse one-sixth horse-power motor which is extremely durable and requires practically no attention. The entire machine is made of metal, is simple in construction and easy to operate. It can be readily moved from place to place, casters being provided to make it slide easily.

✤ ✤ ✤

A Triplex House Pump

THE PUMPING outfit illustrated, is of the triplex type as recently designed by the Buckeye Pump and Mfg. Co., Columbus, Ohio, for house pumping service.

The No. 10 outfit as it is called, has a capacity of 180 gallons per hour, and will pump against pressures of 25 to 50 pounds. The overall dimensions of the complete unit are 17 in. x 13 in. x 12 in. high. The weight is 100 lbs.

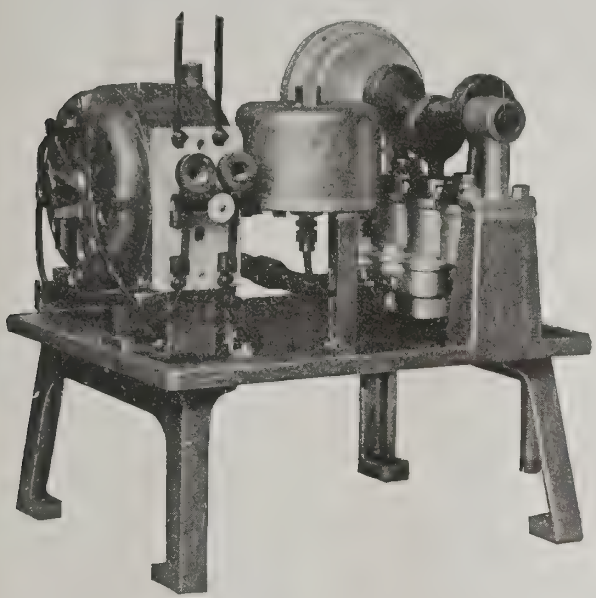
If it is desired to mount the outfit on the wall instead of the floor it can be furnished with brackets instead of the legs shown in the illustration.

The plungers are bronze and are driven by a cam shaft. They are self lubricating. Each cylinder has independent suction and discharge check valves, and therefore any obstruction becoming lodged under one check valve will not interfere with the operation of the other cylinders.

The outfit is equipped with a 1-6 horse-power, Robbins and Myers, direct or alternating current motor as may be specified.

The pump and motor are connected through a worm and spiral cut gear which operate in a tight grease packed case.

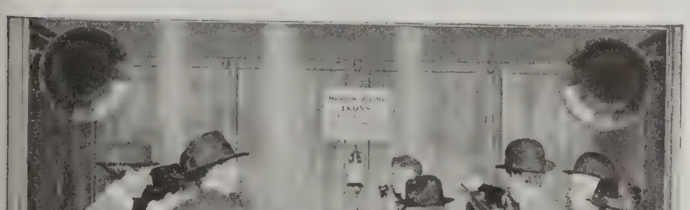
An automatic controller is provided which cuts the motor in when the pressure in the tank falls to 25 lbs. and cuts the motor out when the pressure reaches 50 lbs. A knife switch and fuse block are also furnished, mounted in front of the motor on the base plate.



TRIPLEX HOUSE PUMP USING ROBBINS AND MYERS MOTOR—BUCKEYE PUMP AND MFG. CO., COLUMBUS, OHIO.

The Loud Speaking Telephone

THE drawback to window demonstrations of any character has been the inability of the demonstrator to get his "message across." He could clearly point out the talking points of the article under demonstration, but he could talk about it through the medium of lettered cards only. It is obvious that this method is very unsatisfactory. To overcome the objection and bring the demonstrator nearer his audience, the Western Electric Company, Inc., of New York, has developed its loud speaking telephone euipment in this connection.

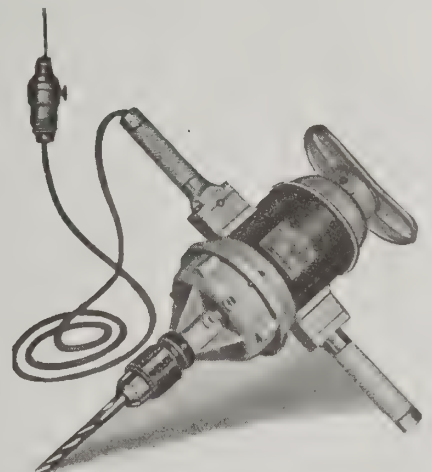


LOUD-SPEAKING TELEPHONE FOR WINDOW DEMONSTRATIONS.—WESTERN ELECTRIC COMPANY, INC., 463 WEST STREET, N. Y.

The equipment consists of a special transmitter and a pair of loud speaking receivers and horns. The operation is simple. The demonstrator connects the horns and receivers on both sides of the window, just high enough to be outside the reach of mischevious youngsters. In series with the transmitter, which is placed inside the window, is wired the battery of six dry cells connected in series and the receivers. The system is then ready for operation. As the demonstrator wishes to bring out each point, he simply speaks into the transmitter and his voice is magnified by the receivers and horns, and carried to the audience outside. The equipment not only brings the demonstrator and his audience in more intimate contact, but serves as an auxiliary attraction to the display itself. It has proved a success wherever used.

Electrical Breast Drill

IN THE illusrtation herewith is shown the new type of half-inch electrical breast drill now being marketed by the Stow Manufacturing Co., Binghampton, N. Y. It is designed for operation from a lamp socket on either alternating or direct currents of 110 or 220 volts. The switch for starting is in the handle, and the tool is provided with ten feet of electric cord with plug for socket attachment. It is claimed that the principal objection to electric drills, the cost of upkeep has been overcome in this type. It is one of the most powerful as well as the most economical drills on the market. The manufacturers will be pleased to send this tool on 30 days trial to responsible parties for test purposes.



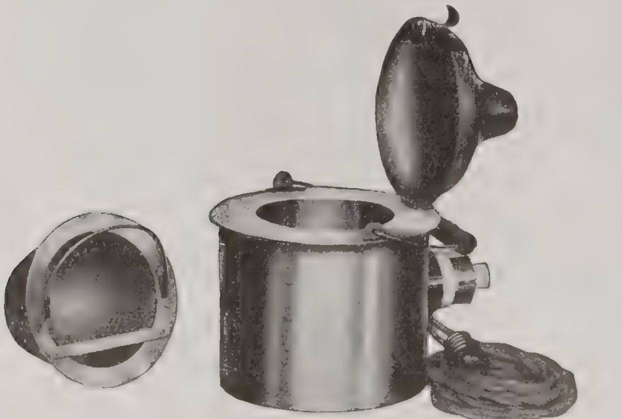
BREAST DRILL FOR ALTERNATING OR DIRECT CURRENT — STOW MANUFACTURING CO., 111 SO. JEFFERSON ST., BINGHAMPTON, N. Y.

A Waterless Glue Heater

A GLUE heater which has recently been put on the market by the International Electric Company of Indianapolis, Indiana, is shown in the accompanying cut. This glue-pot is designed to operate on dry heat, without the use of water, and is built in a variety of sizes. The manufacturers of this article claim that there being no water bath used, there can be no burnouts from the evaporation of the bath.

The heater is built on the fireless cooker principle, with a heat retaining jacket, and the cost of maintaining the glue at the correct temperature, is thereby reduced to a minimum. The one quart heater consumes only one cent's worth of current per day, on the average industrial rate of four cents per kilowatt-hour, and it is claimed that the larger heaters show even greater relative efficiency. The construction is made entirely of heavy spun copper. The heater is portable, and fits any lamp socket. The cover prevents the evaporation, and it is claimed that no skin or scum will form on the glue.

With the International, it is possible to obtain three distinct degrees of heat—high, medium and low. The current is controlled by a three heat, dirt and moisture-proof rotary snap switch, which indicates the various temperatures. High heat is used for melting only, and will melt glue down and bring it to the correct temperature in 25 minutes. The medium heat is used only when the glue pot is in use with the cover open for a considerable length of time, providing a slightly higher degree



GLUE HEATER AND WARMER.—INTERNATIONAL ELECTRIC COMPANY, INDIANAPOLIS, IND.

of heat to allow for radiation. Low heat will hold the glue at an even temperature of about 145 degrees without variation, when cover is closed down, and the heater is not in use, thus, accurate and uniform results are insured at all times.

Although this device has been on the market for a comparatively short time, the manufacturers report that they have met with remarkable success, and have a large number of these heaters in operation. They further report that wherever installed, they are giving perfect satisfaction, and that they have received a large number of repeat orders.

❖ ❖ ❖

Lighting Specialties

A PORCELAIN Mogul Base Socket, equipped either with ⅜-in. or ½-in. aluminum caps, as desired, has been placed on the market by Harvey Hubbell, Inc., of Bridgeport, Conn. This is designed for gas-filled lamps and for use in such places as refrigerating plants and steamships where the corroding elements present would tend to attack a brass shell.

MOGUL BASE SOCKET AND CURRENT TAP.—HARVEY HUBBELL, INC., BRIDGEPORT, CONN.

A rubber gasket assures an absolutely tight joint between the upper and lower portions of this socket making it thoroughly weatherproof and capable of withstanding the ravages of the elements. Long binding screws with generously proportioned heads greatly simplify the wiring permitting ample room for the loop to mat and confining all stray wire ends.

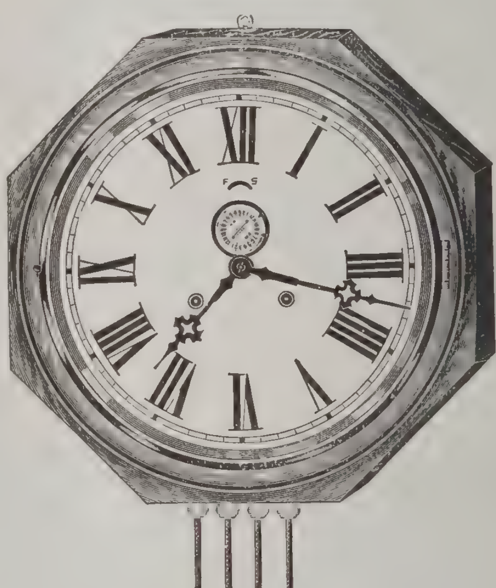
This company has also developed a durable combination Current Tap and Lamp Receptacle made of a tough heat-proof composition capable of withstanding hard usage without damage. While this device was primarily designed to meet the conditions of industrial plants, it is equally adapted to household uses. It is fitted with standard contacts and is interchangeable with the company's line of T-slot wall and flush receptacles.

❖ ❖ ❖

An Automatic Time-Switch

IN THE illustration herewith is shown a new time-switch clock being manufactured by the G. L. Time Switch Company of St. Louis, Mo. This device is approved by the National Board of Underwriters and the switch is rated at 10 amperes, 110 volt capacity.

With the application of this clock to show-windows, the merchant can have his lights turned on at the proper time and turned off again when desired. This may be accomplished by simply setting the switch and the clock does the rest. In this way, one does not have to be inconvenienced by having to leave the dinner table nor stay up late to attend to the lights.



AUTOMATIC TIME-SWITCH.—G. L. TIME-SWITCH COMPANY, 3419 RUTGER STREET, ST. LOUIS, MO.

The clock is of attractive design, finished in solid oak. It has a twelve-inch dial and an eight-day movement. It is accurate and dependable; one winding a week being sufficient for the operation of the switch and the clock. The switch is automatic and so attached to the clock that no strain is brought on the clock's mechanism to affect its operation or accuracy. The complete unit retails at $16.00 to the consumer.

❖ ❖ ❖

Through an error in the transhipment of cuts from Atlanta to New York, there appeared in the advertisement of The Fibre Conduit Company, Orangeburg, N. Y., on page 13 of the November Number of Electrical Age, an illustration belonging to another firm.

In order to clear up any misunderstanding that may have arisen in the minds of our readers, we offer this explanation.

TRADE LITERATURE

Catalogs and Books

A Complete Review of the Latest Publications

A new publication on automobile starting and lighting batteries has been issued by Philadelphia (Pa.) Storage Battery Company. It describes their thin plate Diamond Grid batteries for vehicle and portable service, giving illustrations, dimensions and specifications.

✤ ✤ ✤

Vacuum Cleaners of the Liberty and Magic pattern are treated in leaflets issued by the Innovation Electric Company, 587 Hudson Street, N. Y. These types have been awarded a gold medal at the Panama-Pacific exposition.

✤ ✤ ✤

The Westinghouse Christmas Campaign is the title of an illustrated publication of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. It tells of the work this company is doing to assist the trade handling electric ware, to dispose of them. A copy of this sales-help may be obtained from the company.

✤ ✤ ✤

A folder describing the plan of the Hotpoint Electric Heating Company of Ontario, Cal., has been received. It tells of the company's campaign to increase the sales of household appliances. They are preparing sales-helps for the trade as an aid to new holiday business. For further details apply to the manufacturers.

✤ ✤ ✤

Fine Quality Lighting Fixtures is the title of catalog No. 18 just issued by Shapiro and Aronson, of 20 Warren St., N. Y. It illustrates by neat half-tone cuts many forms of decorative and individual lighting fixtures which may be suited to almost any condition. A copy of this catalog may be secured from the manufacturers upon application.

✤ ✤ ✤

Building a Bigger Business with the Autoprojecter is the title of a leaflet issued by the Automatic Equipment Co., of 261 Broadway, N. Y. It describes a device well adopted for window display advertising, using stereopticon views

✤ ✤ ✤

Catalog No. 7 received from the Dickinson Manufacturing Company, of Springfield, Mass., illustrates various manufactured articles as examples in moulding of electrical insulations and sundry composition goods by the use of their products.

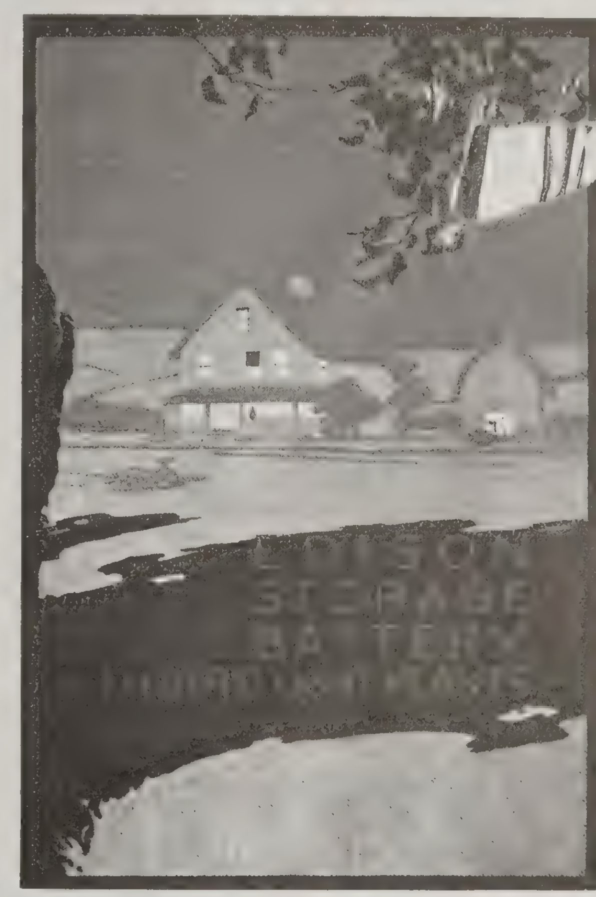
✤ ✤ ✤

Raw-water ice making plants and accessories for such equipments are covered in a new publication of the DeLa Vergne Machine Company, of New York. Illustrations show oil-engine drive and the application of the multiple and double drop-tube system for air agitation. An interesting table gives approximate costs of making ice in oil-engine driven raw-water ice plants.

✤ ✤ ✤

Household Devices is the title of a special bulletin which the Simplex Electric Heating Company, of Cambridge, Mass., is now distributing. Another pamphlet just published deals with lamp socket appliances. These are both intended for the trade handling such heating devices. The catalogs are well illustrated.

Edison Electric Light Plants are described in bulletin 1031-C issued by the Edison Storage Battery Company, of Orange, N. J. It deals with the application of the battery to the lighting of country homes by the use of gasoline engine generator sets.



Cover of Edison Catalog

Simplex Jacks are dealt with in Bulletin 215 issued by Templeton, Kenly and Company, of Chicago, Ill. It describes and illustrates the use of jacks for electric railroads, industries, poles and other purposes, giving dimensions and list prices. The company will send a copy of this publication upon request.

✤ ✤ ✤

Economics of Industrial Lighting is the name of a book dealing with the practical application of the principles of illumination to the lighting of factories and shops. This book is a compilation based "on the highest scientific authorities" and is published by the Cooper Hewitt Electric Company of Hoboken, N. J. Other recent publications of this company are Bulletins 58-A, 61-B, dealing with their products as applied to photographic processes; bulletins 36-D, 44-D and 52 describe various types of their lamps. Copies of these publications may be had gratis by addressing the company.

Kwik-lite products are treated in the latest catalog of the Usona Manufacturing Company, of 1 Hudson Street, N. Y. It describes and illustrates the extensive line of flashlight novelties, electric lanterns and accessories made by this company.

✣ ✣ ✣

Loose leaves from the Metropolitan Engineering Company of New York recently issued, deal with the containers for nitrogen lamps. These bulletins, known as Section 13, give details of reconstruction and method of ventilation for converting arc-lamp shells for use with the gas filled lamps. Metropolitan fixtures are also described.

✣ ✣ ✣

Recording gauges are described in bulletin 98 which the Foxboro Company of Foxboro, Mass., now has ready for distribution.

✣ ✣ ✣

[illegible] such as bench and floor grinders of the [illegible] in a leaflet received from Jas. Clark, [illegible] of Louisville, Ky.

✣ ✣ ✣

The Light-Fingered Foiled is the title of a pamphlet dealing with lamp guards manufactured by Harvey Hubbell, Inc., of Bridgeport, Conn. Various styles of guards are described and illustrated, tables give corresponding list prices. A copy of this folder may be had by applying to the company.

✣ ✣ ✣

A leaflet describing the Eden electric washing and wringing machine has been received from the Carroll Electric Co. of Washington, D. C.

✣ ✣ ✣

Bulletin No. 14 recently issued by the General Lead Batteries Company of Newark, N. J., describes their C. T. batteries for Christmas tree lighting and operation of electric toys. Bulletin 12 deals with hydrometer syrenges and gives information on how to keep informed on the condition of a battery and how to charge it. Copies of this pamphlet may be obtained by applying to the manufacturers.

✣ ✣ ✣

Oil engines working on the two-cycle principle are described and illustrated in catalogs received from Bolinders Company of 30 Church Street, N. Y. These machines are of both the vertical and horizontal types for high and slow-speed duty as may be required and work successfully on heavy crude oil. They are suitable for direct connection to generators.

✣ ✣ ✣

The Revolution in Lighting is the title of a folder issued by National X-Ray Reflector Company of Chicago, Ill. It deals with various lighting methods and their relation to eye-strain, and describes their "eye-comfort" sytem. A list of books which may be obtained free of cost is included.

✣ ✣ ✣

Knife Switches and specialties are treated in catalog 22 recently issued by the Barkelew Electric Manufacturing Company of Middletown, Conn. Various types of switches are illustrated and described; tables give list of prices. The type L motor starter may prove of particular interest for application to a. c. motors. Copies of this book may be had free, by writing the company.

Among the new publications announced by the Bureau of Mines, the following may prove of interest: Bulletin 101, Abstract of current decisions on mines and mining; Technical Paper 97, Saving fuel in heating a house; Technical Paper 104, Analysis of natural gas and illuminating gas by fractional distillation at low temperatures and pressures; Technical Paper 120, A bibliography of the chemistry of gas manufacture. Applications for a free copy of any one paper should be addressed to the Director of the Bureau of Mines, Washington, D. C.

✣ ✣ ✣

The Organization that Developed Air Conditioning is the title of a booklet recently issued by the Carrier Engineering Corporation of 39 Cortlandt Street, New York. It is being circulated to exploit the facilities and experiences of the company in designing and erecting apparatus for washing, cleansing and purifying of air and the regulation of humidity and temperature.

✣ ✣ ✣

A copy of the Exhibitors Weekly Bulletin of the Panama Exposition has been sent by The Bristol Company of Waterbury, Conn. Part of the paper is devoted to a detailed description of the company's comprehensive exhibit of recording instruments.

✣ ✣ ✣

Tools for cutting screw threads are listed in the latest catalog of the J. M. Carpenter Tap and Die Company of Pawtucket, R. I. This illustrates their extensive line of taps, dies, screw-plates, die-stocks, etc., being based on the U. S. Standard threads. Engineering data forms a valuable feature of this publication which is designated as catalog 20. Copies may be had free, by writing to the manufacturers.

✣ ✣ ✣

Test Methods for Steam Power Plants by Edward H. Tenney, B. A. M. E., is a reference work that no power-plant man can afford to miss. It treats of the principles which tend toward economy in the steam-plant and shows the practical application of these principles as an aid in keeping the costs of generation down to a minimum. As the name implies, the book is devoted to test methods and these are so arranged that one may readily refer to them for the simple analysis of any condition under consideration. As set forth in the introduction, the methods which are here brought together are those which the author has found to be most satisfactory as regards simplicity and speed of operation, at the same time conforming to strict accuracy and as far as possible, with already standardized methods of testing. Among the topics treated are the purchase and testing of coal, investigation of the economy of combustion, treating and testing water for boiler-feed purposes, methods of testing prime movers and the testing of power-plant lubricants. Size 5¼ by 7½ in., 224 pages, 85 illustrations and 39 tables. Price $2.50, published by D. Van Nostrad Company, 25 Park Place, N. Y.

✣ ✣ ✣

How to Make a Tranformer for Low Pressures by F. E. Austin, now appears in the form of a second edition. This little book is designed for the man who not only experiments but builds his own apparatus. By following the instructions given, it is possible to build a small transformer at a low initial cost and without the use of expensive tools. The examples cover transformers for 110 and 220 volts at a frequency of 60 cycles. Price 40 cents. Published by the author, Prof. F. E. Austin, Box 441, Hanover, N. H.

Review of the Month

A Complete Record of Important News Edited for Busy Readers

A long step toward the completion of the proposed safety code of the Bureau of Standards, was taken at the conference held the last week in October and first week in November, at the headquarters of the American Institute of Electrical Engineers. The following associations and corporations sent representatives:

Western Association of Electrical Inspectors, Associated Manufacturers of Electrical Supplies, National Electric Light Association, Association of Edison Illuminating Companies, Electrical Manufacturers' Club, Bureau of Standards, American Institute of Electrical Engineers, American Electric Railway Association, National Electrical Contractors' Association, Canadian Electrical Association, Underwriters' Laboratories, Northwest Electric Light and Power Associations, New York Central Railroad, Pennsylvania Railroad, Wisconsin Industrial Commission, American Telephone and Telegraph Company, the Western Union and Postal Telegraph companies, California Industrial Accident Commission, Westinghouse, General Electric and other manufacturers, as well as various central station interests.

When the conference opened on October 25th, four subcommittees were appointed to cover the following subjects: *Station*: D. W. Roper, of the Commonwealth Edison Company, chairman. *Line*: R. J. McClelland, of the Electric Bond and Share Company, chairman. *Utilization*: R. S. Hale, Edison Electric Illuminating Company, of Boston, chairman. *Operation*: P. Jinkersfeld, of the Commonwealth Edison Company, chairman.

During the first week, one day or more was given over to each committee, the mornings being taken up with general discussions of the various subjects and the committees going into session in the afternoon.

It was found necessary to rewrite some of the provisions of the safety code, in order to make their scope clearer. After much discussion it was decided to provide a number of alternate methods to fit the differences in practice in various sections of the country.

It is expected that the Bureau of Standards will send out revised copies of the proposed safety code within a short time. After this the matter will be placed before the various public service commissions, etc. All this will take considerable time, and it is thought that the public conference in Washington will not be held until after the first of the year.

✣ ✣ ✣

The formation of the new Technical and Hydroelectric Section of the N. E. L. A. was completed at the meeting of the Executive Committee in New York on November 3rd. The Committee had been requested by President Lloyd in accordance with the recent authorization by the National Executive Committee to organize the Section and the following officers were elected: Chairman, Holton H. Scott; vice-chairmen: P. M. Downing, J. T. Hutchings, R. J. McClelland, Charles Ruffner; secretary, S. A. Sewall.

These officers will constitute the governing body of the Section until the regular election of officers by the Section itself at the next annual convention.

All the Technical members of the main association become members automatically of the new Section and new members will be added to the Section on their personal choice. The Technical membership of the association is by far the largest group and the new Section will consist of several thousand members. It will take under its jurisdiction practically all of the Technical Committees such as Overhead Line, Prime Movers, Electrical Apparatus, Underground Construction, Grounding Secondaries, Electrical Measurements, etc.

It was proposed by Mr. Torchio that a new committee be constituted to study and report on the newer industrial applications of electricity from the technical side so as to be of use in furnishing data and information to member companies and the Commercial Section. This proposition was very favorably considered.

Steps were taken to formulate a constitution for the Section and a variety of interesting business was discussed.

✣ ✣ ✣

A meeting of the Wiring Committee of the N. E. L. A. was held at Schenectady, N. Y., on November 12. The session was taken up with a discussion on the concentric wiring system, standard attachment plugs, solid instead of fused neutrals, the use of colored wires to facilitate the selection of neutrals, and other matters.

✣ ✣ ✣

An exhaustive investigation of export business, and conditions governing American foreign trade, is being made by the Federal Trade Commission. It has just been announced that 30,000 letters of inquiry will soon be sent out to a number of men who were unable to appear at the public hearings already held in this connection. About 20,000 letters will go to American manufacturers and producers in every important branch of industrial enterprise, and about 10,000 will be sent to other authorities on foreign trade conditions, such as export commission merchants, manufacturing export agents, importers, domestic bankers etc. A return postcard accompanying the letter is designed to give the Commission a broad yes or no referendum on the advisability of export combinations, and to put it in touch with those who are willing to assist the Commission by furnishing further facts and suggestions.

✣ ✣ ✣

The Bureau of Foreign and Domestic Commerce, Washington, announces that it has issued a booklet, entitled "Commercial Organizations in Switzerland," which gives authoritative information on trade and commercial organizations, commercial publications, principal products, etc., of that country. This is in line with the monographs on Germany, France and the United Kingdom, which have already appeared, and which are designed to assist American business men who desire to enter the foreign field.

✣ ✣ ✣

A review of what has been and is being done by the Department of Commerce to push the trade of the United States with Central and South America is presented in a letter from Secretary William C. Redfield to Senator Francis S. White, of Alabama. This statement, giving details of the work of commercial attaches and special agents of the Bureau of Foreign and Domestic Commerce, a letter from the Senator, making inquiry as to what has been done to press the sales of the products

of Southern manufacturers in Latin American countries. The letter in part is as follows:

October 26, 1915.

My dear Senator: It gives me great pleasure to comply with your request of October 8th for information as to what the Department of Commerce has been able to do for manufacturers of the South in extending their trade in Central and South America.

Since you refer particularly to the work of special agents who have been sent by the Bureau of Foreign and Domestic Commerce to Latin America, this branch of the service will first be described, but you must bear in mind that it is only one phase of the Department's efforts to increase our trade with Central and South America.

Under the appropriation of fifty thousand dollars "to further promote and develop the commerce of the United States with South and Central America," fortunately made available for the last fiscal year when the opportunity presented to our manufacturers, and likewise the difficulties to be encountered by them, were exceptional, it was possible to appoint ten specialists along particular lines, selected in accordance with the most pressing needs of American manufacturers and exporters. These special agents were directed to investigate in the various countries of Central and South America to the markets for hardware, machinery and machine tools, electrical appliances, wearing apparel, lumber, and furniture to gather general trade information, and to study transportation finance and banking, and commercial laws. Of the reports of these agents one entitled, "Financial Development in South American Countries," (Special Agents Series No. 103), has been recently published. Others are either in press or in course of preparation for the printer and within the next month or two most of the reports will be available for distribution.

✣ ✣ ✣

An enthusiastic meeting of the American Institute of Electrical Engineers was held on October 19 and 20 under the auspices of the St. Louis Section of the Institute. Among the papers presented were: "The Repulsion-Start Induction Motor," by J. L. Hamilton; "Single-Phase Squirrel-Cage Motor With Large Starting Torque and Phase Compensation," by V. A. Fynn; "Calculation of Long-Distance Transmission Lines Under Constant Alternating Voltage," by G. R. Dean; "Municipal Co-Operation in Public Utility Management," by P. J. Kealy; "Automatic Control," by C. W. Place; and "Recent Results Obtained From Preservation Treatment of Telephone Poles," by F. L. Rhodes and R. F. Hosford.

✣ ✣ ✣

The Philadelphia Section of the Electric Vehicle Association of America, elected the following officers, at a meeting held October 26: R. L. Lloyd, chairman; E. S. Hare, vice-chairman; H. H. Doering, secretary.

✣ ✣ ✣

At a meeting of the Council of the Illuminating Engineering Society held November 11, it was announced that a special edition of the "Code on Lighting of Mills and Factories" would be published shortly. This edition is to be distributed to factory, mill, legislative, lighting and other authorities at a nominal price.

Nine applicants were elected associate members. The Malden (Mass.) and Melrose Gas Company (Revere, Mass.), and the Harverhill (Mass.) Electric Company were elected sustaining members. Twenty-one associate members were transferred to the grade of member.

Hereafter the badge of associate members is to have a maroon field, while that of members will be blue. A new membership certificate is to be designed and issued in the near future.

Mr. C. A. Littlefield was appointed general secretary to succeed Mr. Alten S. Miller, resigned.

Further arrangements were made for the semi-annual convention, which is to be held early next February to mark the tenth anniversary of the organization of the society. Plans for the proposed course of lectures, similar to that given at Johns Hopkins University in 1910, under the joint auspices of the University and the society, were discussed but the place and definite dates were not set. It has been decided, however, that the course will be given early next fall, probably immediately following the annual convention which is usually held the latter part of September.

Those present at the meeting were: Charles P. Steinmetz, president; E. M. Alger, C. O. Bond, H. Calvert, H. A. Hoadley, Clarence L. Law, A. S. McAllister, J. L. Minick, L. B. Marks. Upon invitation C. E. Clewell and G. H. Stickney.

✣ ✣ ✣

Three interesting papers were presented at the November meeting of the Pittsburgh, Pa., Section of the Illuminating Engineering Society, held on November 19th. G. W. Rosa, spoke on "Can Light Be Measured?", H. H. Magdsick on "Instruments That Are Used in Measuring the Quantity of Light," and Dr. L. O. Groudahl, on "Instruments That Are Used in Measuring Quality of Light."

✣ ✣ ✣

The November meeting of the New York Section of the Illuminating Engineering Society, held on the 11th, was a joint meeting of the American Electrotechnical Society and the I. E. S. The subject treated was "Electrical Phenomena in Vapors and Gases." W. G. Cady, of Wesleyan University, spoke on "Unstable States in the Arc and Glow;" D. McFarlan Moore delivered a paper on "The Gaseous Conductor Light," and W. A. Darrah, described recent investigations in connection with the "Electric Arc in Complex Vapors at Reduced Pressures."

✣ ✣ ✣

It is announced that the New York Edison Company and allied companies has established a sick benefit fund and service annuity plan—the latter corresponding to a long service pension provision—for their employes.

The New York Edison Company has volunteered to pay into the sick benefit fund 50 percent, or half, of the dues of employes who become participating members. In other words, an employe who is receiving $36 a week would, in case of illness, receive $28.80 a week by the weekly payment of 40 cents, but which, to the employe member, would amount only to 20 cents a week. The company will also administer the fund and provide the medical service. A member of the fund will receive a sick benefit not exceeding 80 percent of his regular wages up to a limit of six months.

The service annuity will give an employe who is at least fifty years old, and has rendered satisfactory service to the company continuously for twenty-five years an annuity or pension at the rate of 2 percent of the wages for each year of service up to a maximum of 60 percent of the average wages during the last five years of service.

✣ ✣ ✣

According to recent cable dispatches from Sweden, this year's Nobel prize for Physics has been awarded to Thomas A. Edison and Nikola Tesla. It is gratifying to note that these two great Americans have at last received recognition for their great services in the realm of electrical science.

Of the two men, Edison is perhaps the better known, and certainly he has been more prolific in inventions, but Tesla ranks as one of the master minds of research into the unknown, and his inventions have been mostly of a distinctly original character.

✣ ✣ ✣

Plans for a gigantic hydroelectric project in southern Montana and northern Wyoming are under way, according to S. B. Williamson, chief of the Denver office of the United States Reclamation Service. The plans of the promoters of this development include the harnessing of the Big Horn river and penning it in an enormous natural reservoir, formed by an artificial dam at a point forty-five miles southeast of Billings, Mont., and sixty miles northwest of Sheridan, Wyo. This dam,

according to the figures of the engineers working on the project, will be the largest of its kind in the world—415 feet high, 1,000 feet wide, 400 feet thick at the base, and 30 feet thick at the top. Electrical horsepower, estimated from 170,000 to 200,000 will be generated from this supply.

❖ ❖ ❖

The organization of the Western Electric Company, Inc., under the laws of New York, was recently announced. Capitalization is $15,750,000. The new company will succeed the business of the old Western Electric Company, but the latter will continue its corporate existence. The management and officials will be identical with that of the old company.

❖ ❖ ❖

Some highly successful and well attended meetings were held by the Philadelphia Electric Company section of the N. E. L. A. during October. President Joseph B. McCall addressed the opening meeting on October 18th on the subject of "Preparedness on the Part of the Employe." The opening meeting of the Commercial Branch was held on October 25th. The November meeting of the Engineering Department Branch was devoted to a discussion of the Steam Flow Meter, while the November meeting of the Meter Department Branch held a discussion on meters of various types.

❖ ❖ ❖

The thirty-seventh annual meeting of the American Society of Mechanical Engineers will be held at New York, December 7-10. The following is a partial list of the papers to be presented:—Gas Producers with By-Product Recovery, by Arthur H. Lynn; Application of Engineering Methods to the Problems of the Executive, Director and Trustee, by Hollis Godfrey; Modern Electric Elevator and Elevator Problems, David Lindquist; Turbines vs. Engines in Units of Small Capacities, J. S. Barstow; The Connors Creek Plant of the Detroit Edison Company, by C. F. Hershfield; Proportioning Chimneys on a Gas Basis, by A. L. Menzini; Higher Steam Pressures, Robert Cramer; Novel Method of Handling Boilers to Prevent Corrosion and Scale, A. H. Babcock; Electric Operation and Automatic Electrical Control for Machine Tools, by L. C. Brooks; Heat Insulating Properties of Commercial Steam Pipe Covering, by L. B. McMillan; Peformance and Design of High Vacuum Surface Condensers, by Geo. H. Gibson and Paul A. Bancel; Modern Movement for Safety from the Standpoint of Manufacturer; Methods of Reducing Accidents Through Co-operative Movement with Workmen, and Compulsory Compensation for Accidents by Law.

❖ ❖ ❖

A resolution commending the Stevens Bill was adopted by the Independent Retailers of the Metropolitan District, New York, at a mass meeting held on October 27th.

❖ ❖ ❖

A special organization was formed in Milwaukee, Wis., known as Milwaukee Electric Show Association, for the purpose of furthering "Electrical Prosperity Week" by holding an electrical show during that period.

The officers of the new association are: President, R. M. Van Vleet, of the Cutler Hammer Co.; vice-president, Philip Grossman, of the Electrical Engineering & Equipment Co.; treasurer, P. C. Burrill, of the Herman Andrae Elec. Co.; secretary, S. J. Gates, of the Milwaukee Electric Railway & Light Co.

The show was staged on the first and second floors of the University Building. The first floor was devoted to the heavier apparatus, and the second floor to fixtures, household appliances, etc.

Some 10 days prior to the opening of the show, Electric Booster Trips were made on a large electric flat-car to various towns on the Interurban Lines in the vicinity of Milwaukee. The car was fitted with a canopy and contained various exhibits. Other cars were provided for representatives of exhibitors, the Boosters being the guests of the traction companies.

An extensive power merger has just been completed by S. Z. Mitchell of the Electric Bond & Share Company, among the principal electric power properties of southern Idaho. The combination represents a property consolidation of between $15,000,000 and $20,000,000.

The combination of the properties has resulted from their having been taken over by the bondholders, the bondholders of the Idaho-Oregon Power Company having organized the Electric Investment Company, and the bondholders of the Idaho Railway, Light & Power Company having effected the organization of the National Securities Corporation. The Idaho Power & Light property being practically an acquisition of the Idaho Railway, Light & Power Company, came as a result into the possession of the National Securities corporation, which finally acquired the holdings of the Electric Investment Company and continues operation under the latter name.

❖ ❖ ❖

Earnings of the Public Service Comporation of New Jersey for the nine months ended September 30 showed a gross increase in the total business of $968,713, or 3.7 per cent. over the corresponding period a year ago.

❖ ❖ ❖

The Dayton Power and Light Company, of Dayton, Ohio, reports an increase of 18.2 per cent. in gross earnings for September, and the actual business for the twelve months ended September 30 was $1,025,109, as against $915,313 for the year preceding.

❖ ❖ ❖

The reorganization plan of the Kansas City Railway and Light Company, embracing the street railway and electric light systems in Kansas City, has resulted in deposit of more than 97 per cent. of all the matured bonds and notes by holders of these securities, and the board of managers, composed of Kuhn, Loeb & Co., Lee, Higginson & Co., and Blair & Co., announces that the plan has been declared operative.

❖ ❖ ❖

The City Council of Atlanta, Ga., has adopted an ordinance repealing the present law creating the board of electrical control, so that a new law may be passed taking the chief of the fire department from the board, and adding to it all the members of the committee on electric lights.

❖ ❖ ❖

An opinion was recently rendered by the Missouri Public Service Commission to the effect that it has no power to compel utility corporations, except railroads, to refund overcharges. This decision was made in connection with complaints against the Union Electric Light and Power Company, of St. Louis, Mo.

❖ ❖ ❖

The Pennsylvania Public Service Commission will resume hearings in the cases involving rates and service of the Philadelphia Electric Company, in Harrisburg, on December 17.

Chairman Ainey, of the commission, stated that the time had been agreed upon at a conference in Philadelphia, and was chosen as the earliest reasonable date following the completion of the inventory and appraisal of properties of the company, upon which the company's experts have been engaged for a long time. The chairman said the Commission would hold hearings without permitting any lengthy adjournment until the case was concluded. The hearings will cover both municipal and domestic services and rates.

❖ ❖ ❖

Public Service Commission of Northern New York has approved the franchises granted by the City of New York to the Yonkers Electric Light & Power Company and the Westchester Lighting Company, for the construction of an electric transmission line along the aqueduct lands in the county of Westchester, and a contract whereby these companies and the New York Edison Company and the United Electric Light & Power Company, may use the line in return for furnishing the city with current which it will need in operation of the aqueduct.

A vote to establish a municipal electric light plant at Marietta, Ohio, was defeated.

✣ ✣ ✣

It is reported that the Union Electric Light and Power Company, St. Louis, Mo., will on or about December 1, make a further reduction in residence electricity rates from 10 cents to 9 cents maximum charge per kilowatt hour.

✣ ✣ ✣

A considerable reduction in electric light and power rates became effective in New Orleans, La., on December 1. The New Orleans Railway and Light Company has agreed to a lighting rate of 7 cents maximum and 4 cents minimum per k. w. h., and a power rate of 6 cents maximum and 3½ cents minimum per k. w. h.

✣ ✣ ✣

The voters of Lorain, Ohio, killed, by an overwhelming majority, the proposal to issue $350 000 worth of bonds, for building a municipal lighting plant. It is believed that the Citizens Gas and Electric Company will obtain franchise from the city.

✣ ✣ ✣

The municipal lighting plant at Dover, Del., has found it necessary to increase the rates for electricity from 6 cents to 8 cents per k. w. h. The plant has proven unprofitable on the old basis.

✣ ✣ ✣

At the annual meeting of the Minneapolis Order of Jovians, O. A. Rofelty, of the Minneapolis General Electric Company, was elected Tribune; O. Curtis, second Tribune; H.E. Brillhart, secretary, and Wm. Baker, treasurer.

✣ ✣ ✣

The Electrical Credit Association held its twentieth annual meeting and dinner on November 4th. Many interesting discussions were held on the problems constantly encountered by the credit men. Officers elected for the ensuing year are as follows: C. A. Terbush, president; W. T. Pringle, vice-president, and J. W. Crum, secretary and treasurer.

✣ ✣ ✣

"The Effect of Light on Colors" was the subject of an interesting paper read at the November meeting of the Electro-Technic Club, of the Fort Wayne Electric Works, Fort Wayne, Ind.

✣ ✣ ✣

Some fifty members were present at the meeting of the Committee on New Business, of the Ohio Electric Light Association, which was held in Middletown, Ohio, on November 17th. A number of interesting discussions and addresses were heard, among them a paper by W. A. Wadsworth, of Cincinnati, on "Electrical Advertising" and another by F. S. Dellenbaugh, of East Pittsburgh, on "Increasing Small Motor Loads on Central Station Circuits." After the close of the convention, the delegates inspected the plant of the American Rolling Mill Company.

✣ ✣ ✣

Springfield, Mo. can now boast of a local chapter of the Order of Jovians, which was installed at a banquet tendered to local members of the society and candidates, by A. F. Van Deinse, general manager of the light and traction company properties of that city.

✣ ✣ ✣

The Electric Meter Committee of the Empire State Gas and Electric Association, held a well attended meeting on November 12th, in Poughkeepsie, N. Y. Chairman C. P. Durfee opened the meeting, a feature of which was the demonstration and general discussion of the watt-hour demand indicator. Representatives of various meter manufacturers were present at the session.

✣ ✣ ✣

The Kansas Gas, Water, Electric Light and Street Railway Association held its eighteenth annual convention at Topeka, Kans., October 21-22. Many interesting papers were read and discussed. It was decided that the association should change its name to the Kansas Public Service Association. Topeka will probably be chosen as permanent headquarters for the future.

✣ ✣ ✣

E. W. Jansen, of the Illinois Central Railway, was chosen head of the Association of Railway Electrical Engineers at their annual convention held in Chicago, on October 19, 20, 21 and 22. Some thirty manufacturers were represented in the exhibition of the latest equipment, etc., held at the Hotel La Salle in connection with the meeting.

✣ ✣ ✣

The Lionel Manufacturing Company, manufacturers of electrical toys, have purchased a site 235x225 feet on the west side of South Street, near Clinton Avenue, Newark, N. J., and will erect a modern new factory thereon.

✣ ✣ ✣

The Vanderpool Electric Manufacturing Company, of Litchfield, Conn., has increased its capital stock from $75,000 to $125,000.

✣ ✣ ✣

The C. J. Litscher Electric Company, of Lansing, Mich., has filed notice of increase in capitalization from $75,000 to $150,000.

✣ ✣ ✣

A hydro-electric power plant is to be erected at Waneta, British Columbia, at the confluence of the Columbia and Pend Oreille rivers, according to a recent report. A dam will be constructed and the plant is expected to develop 80,000 horsepower. More than $1,000,000 is to be expended in construction and equipment by British capital.

✣ ✣ ✣

The Nashville, Tenn., branch of the Western Electric Company, of Atlanta, was recently damaged by fire to the extent of $75,000.

✣ ✣ ✣

The Toledo Electric Welder Company Cincinnati, Ohio, has increased its capital stock from $75,000 to $150,000.

✣ ✣ ✣

The Home Specialty Manufacturing Company, manufacturers and dealers in all kinds of electrical specialties, has been incorporated in Cleveland, Ohio, with a capital stock of $40,000. The incorporators are A. B. Betz, G. F. Collister, F. C. Maxheimer, J. Kirby and R. W. Edwards.

✣ ✣ ✣

It is reported that the O. K. Electric Company, manufacturers of electrical specialties, will locate in Benton Harbor, Mich.

✣ ✣ ✣

The Sunnyside Electrical Company, which now operates a power plant in Wheeling, W. Va., is to erect a 100,000 k. w. plant near Steubenville, Ohio, in the near future. It is stated that the company plans to supply power to many cities in Eastern Ohio from the new plant.

✣ ✣ ✣

The Lykens Valley Light and Power Company has bought the plant of the Williams Valley Light, Heat and Power Company, in Wisconsisco township, Pennsylvania.

✣ ✣ ✣

The Cadillac Water and Light Company, of Cadillac, Mich., has changed its name to the Consumers Power Company. The company is a branch of the Commonwealth Power Company.

✣ ✣ ✣

Gross income of the Helena Light and Railways Company, of Helena, Montana, for the year ending October 31st, was increased to $319,680, while net earnings of $101,241 made an advance of 4.20 percent over the year preceding.

✣ ✣ ✣

The Commonwealth Edison Company, of Chicago, Ill., is installing a new sixty cycle turbo generator, which will have a capacity of 35,300 kilowatts. The new generator will be installed in the northwest station of the company and is to be in readiness for operation in the fall of 1916.

The Connecticut Company, of Hartford, Conn., is planning to rebuild and enlarge its power house. The work, it is estimated, will cost about $197,000.

❖ ❖ ❖

It is reported that the Wisconsin-Minnesota Light and Power Company, which recently took over the property and franchises of the Chippewa Valley Light and Power Company, of Chippewa Falls, Wis., is to erect a large hydro-electric power plant at Dunnville, Wis. The same corporation has also applied to the State Railway Commission for permission to erect a dam three miles above Chippewa Falls, to develop 42,000 horsepower. This involves an investment of over $2,000,000.

❖ ❖ ❖

The Stewart Electric Company, of Cincinnati, Ohio., is erecting a $1,000 000 power plant at Apraw Falls, two miles south of Bickwell, Ind. The company has signed contracts to furnish power to all the larger surrounding cities.

❖ ❖ ❖

It has been announced that the Vermont Power and Manufacturing Company, St. Albans, Vermont, will be absorbed by the Public Electric Lighting Company, a corporation recently formed in Massachusetts, and in future it will be known by that name.

❖ ❖ ❖

The formation of a $1,000,000 corporation, to be known as the Central Power Corporation, of Vermont, with principal office at Middlebury, is being promoted by C. H. Thompson, of Montpelier; C. P. Johnson, of Lexington, Mass.; Robert L. Ryder, of Boston, and others. The purpose of the company is given as "the construction of reservoirs and power plants for generating electricity, etc."

❖ ❖ ❖

A bill of complaint has been filed by a number of stockholders of the Uncas Power Company, of Windham, Mass., asking that a receiver be appointed and that the corporation be dissolved. The corporation operates a hydro-electric station of about 5,000 000 k. w. annual capacity.

❖ ❖ ❖

The Safety-Armorite Conduit Company, manufacturers of Loricated and Galvaduct Iron Armored Conduits, Pittsburgh, Pa., have opened an Eastern office at 50 Church Street, New York, in charge of Wm. G. Campbell, and will hereafter sell its product direct in that territory, instead of through selling representatives.

❖ ❖ ❖

Colorado Power Company, Denver, Col., has absorbed the Monte Vista Light, Heat and Power Company, of Monte Vista, Col.

❖ ❖ ❖

The Consumers Power Company, Bay City, Mich., has purchased the property of the Bristol Electric Light Company, of Midland, Mich. A transmission line will be constructed from Bay City to Midland.

❖ ❖ ❖

A decision, of interest to railroad men and particularly to car-lighting men, was handed down, on November 4th, by Judge Hazel in the United States District Court, Western District of New York. It will be remembered that recently Judge Hazel, sitting in this court, sustained the Creveling Patent 747,686. It was maintained by the owners of this patent that the decision was broad enough to cover the use of the ampere-hour meter system of car-lighting as put out by the U. S. Light & Heat Corporation, of Niagara Falls, N. Y., and it was sought to bring this system into the accounting ordered by the court. The court held that the present standard car lighting equipment, involving the use of an ampere-hour meter to control battery charging, as put out by the U. S. Light & Heat Corporation, does not come under the injunction or the accounting ordered in the prior decison sustaining the Creveling patent.

Personals

Paul M. Lincoln, former president of the American Institute of Electrical Engineers and connected for a number of years with the Engineering Department of the Westinghouse Electric and Manufacturing Company, has resigned his position with that company, in order to devote his time to the manufacture of a meter which he has recently invented.

Mr. Lincoln is one of the best informed men in the country on power transmission line engineering and operation.

❖ ❖ ❖

Halbert P. Hill, well known in engineering circles, as an inventor and designer in early development of the rotary converter and allied apparatus for the conversion of alternating current into direct current, is now connected with the C. & C. Electric & Mfg. Co., of Garwood, N. J. Mr. Hill is most popularly identified with reference to Hill appartus covering both horizontal and vertical, ball bearing motor generator sets for moving picture machines and battery charging outfits.

❖ ❖ ❖

Dr. C. P. Steinmetz, of the General Electric Company, has apparently widened the sphere of his activities in the form of extended public service. At the last election he was made President of the City Common Council at Schenectady, N. Y., having run on the Socialist ticket.

❖ ❖ ❖

D. A. Hegarty, formerly general manager of the Houston, Texas, Lighting and Power Company, has recently been elected president of the Texas Southern Electric Company. He is succeeded in Houston by S. R. Bertron, formerly general manager of the Consumers Light and Power Company, of New Orleans.

❖ ❖ ❖

Robert W. Hoy, for twenty-eight years connected with the Harrisburg Light and Power Company, of Harrisburg, Pa., has recently become commercial manager of the Elmira Water, Light and Power Company, of Elmira, N. Y.

❖ ❖ ❖

J. O. Montignani has recently been appointed engineer in charge of electrical distribution for the Rochester Railway and Light Company, Rochester, N. Y.

❖ ❖ ❖

Norman McD. Crawford has resigned as president and general manager of the Reading Transit and Light Company, Reading, Pa., effective on November 1st.

❖ ❖ ❖

Deadrick H. Cantrell, president of the Little Rock Railway and Electric Company, has been elected a director of the American Cities Railway Company, of New Orleans.

❖ ❖ ❖

Elbert L. Benton, until recently superintendent of the Lockport Light, Heat and Power Company, of Lockport, N. Y., has sailed for Europe to enter the service of the British government.

❖ ❖ ❖

C. I. Crippen, for the past three years general superintendent of the light and power departments of the West Penn. Elctric Company, Wheeling, W. Va., has recently become associated with the commercial department of the Republic Railway and Light Company, of Youngstown, Ohio.

❖ ❖ ❖

D. S. Miller, of New Haven, Conn., has recently been appointed superintendent of power and light of the Reading Transit and Light Company, Reading, Penna.

❖ ❖ ❖

Obituary

T. W. Jackson, engineer and contractor, with headquarters at Cincinnati, Ohio, for many years a representative of G. M. Gest, died on November 19, after several weeks illness. Mr. Jackson was well known in the Middle West and South by all interests who have had any conduit construction done within the past twelve years.

BUSINESS OPPORTUNITIES

ALABAMA

Ashland.—Southern Graphite Company of this city is desirous of securing prices on electric motors of 25, 50 and 75 hp. units.

Fairhope.—This city is about to install a $10,000 electric light plant, to develop 50 to 75 hp.

ARKANSAS

Mountain Home.—City Council has granted a franchise for electric light plant which will be constructed by the Mountain Home Electric Power Company. To develop about 100 hp.; capacity 3,000 lamps.

Newport.—Arkansas Light and Power Company is to construct an electric transmission system from Newport to Tuckerman.

Ozark.—E. C. Bill and Arthur DuPriest have purchased the local electric light plant.

Tuckerman.—Citizens Light & Power Company has been chartered here with a capital stock of $10,000, by L. D. Smith, L. T. Slaydon and William Laner.

Yellville.—The Yellville Light, Ice and Power Company is about to construct an electric light and power plant here. W. C. Stephenson is the manager.

CALIFORNIA

San Francisco.—The Pacific Gas and Electric Company has received permission to issue $1,447,500 bonds and stocks. Most of this will be expended in plant improvements and extensions to distributing systems.

CONNECTICUT

New Haven.—United Illuminating Company of this city has increased its capital stock from $3,000,000 to $3,500,000.

DISTRICT OF COLUMBIA

Washington.—Work will soon be started on power plant, tunnel system, etc., which on completion will supply various government buildings with light, heat and power. Power plant building will be 178x129 feet. It is estimated that the work will cost over $1,500,000.

FLORIDA

Clearwater.—Franchise has been granted to J. N. and J. M. McClung, of this city to construct an electric heating, lighting and power system for Clearwater and nearby cities.

Fort Pierce.—City council has passed an ordinance providing for issuance of $25,000 bonds to extend electric light system.

Homestead.—City has voted $40,000 bonds to construct electric light plant, etc.

Ocala.—Florida Power Company is contemplating the construction of a high tension electric system branching from its present line near Istachatta to Orlando, a distance of about 67 miles.

St. Cloud.—W. A. Ginn, Sanford, Fla., has been commissioned to prepare plans for the construction of an electric light plant in this city.

Webster.—Town council is considering granting of franchise to construct electric light and water plants.

Winter Haven.—Winter Haven Water, Ice and Light Company is constructing a new power house and machine-shop annex.

GEORGIA

Davisboro.—Plans have been prepared for an electric light plant for this city. W. Hopson Goodloe, Macon, Ga., engineer.

Graymont.—City council of this city and that of Summit, Ga., are planning the erection of an electric light plant to serve both cities. Plant to cost about $10,000. W. Hopson Goodloe, Macon, Ga., is in charge.

Metter.—It is planned to erect an electric light plant in this city to cost about $7,500. Bonds to be voted on in December.

INDIANA

Hebron.—Hebron Light, Heat and Power Company has been chartered in this city with a capital stock of $25,000, by Fred A. Bremer, Charles B. Alyes, William J. Mulinex, Ralph Alyes and David B. Fickle, to generate and sell electric current.

Laporte.—Wanatah Electric Company has been organized in this city by H. H. Keller, A. H. Kimple and Lemuel Darrow. Capital stock $5,000.

IOWA

Clarinda.—The Clarinda Electric Light Company is tearing down its power plant here and plans to erect a larger one on the same site. Total cost will be about $80,000, and building 40x40 feet. Capacity will be increased to 2,000 kilowatts. Plant supplies ten different towns at present and it is the intention to extend the service very largely.

KENTUCKY

Berea.—Isaacs and Baker Company, which recently purchased the electric light and power plant at this place are planning to install new equipment to cost about $12,000.

Clay.—Clay Light and Ice Company is adding additional equipment to its plant here, and will considerably extend its service.

Flemingsburg.—Flemingsburg Light and Ice Company is to change its system from direct to alternating current, 2,300 volts, and install equipment, including complete generating unit consisting of 75-kva. generator, transformers, etc.

Louisville.—Louisville Gas and Electric Company is to erect a 35x70 substation at Bardstown and Stevens Ave., to supply electricity in Highlands District. Also make improvements and extensions to underground distributing system. H. M. Byllesby and Company, Chicago, will have charge of improvements.

Mayfield.—City has voted to purchase the electric light and power plant of the Mayfield Water and Light Company.

Providence.—City has voted $20,000 bonds for the erection of an electric light plant here.

Whitesburg.—W. W. Gibson and son, Mater, Ky., are installing a new electric light plant here.

LOUISIANA

Mandeville.—St. Tammany-New Orleans Railway Company has secured a five year contract from this city for new street lighting system.

Opelousas.—City plans rebuilding of electric light plant lately damaged by fire, loss $21,000.

Rayville.—City purchased People's Light and Power Company's plant and will operate same.

White Castle.—City is to construct electric-light plant Xavier A. Kramer, engineer, Magnolia, Miss.

MARYLAND

Baltimore.—City has authorized R. C. Thomas, Chief Engineer, Electrical Company, to resume construction work on municipal conduit system to extent of $15,000.

Baltimore.—Enterprise Steam and Hot Water Company, 600 N. Howard Street, has contract to install power plant for various large buildings here.

Easton.—Newton Electric Company is planning the construction of an electric transmission system from Easton to Oxford, a distance of about 15 miles. To secure electricity from municipal electric plant at Easton.

Frederick.—City is considering the construction of an electric light plant.

MASSACHUSETTS

Boston.—Public Electric Light Company has been chartered here with a capital stock of $320,000, by David V. Carruth, Walter R. Dame, Arthur L. Auger, William H. Tyler and John W. Ogden.

Holyoke.—City has authorized a $100,000 bond issue for the enlargement of the city lighting plant.

MISSISSIPPI

Clarksdale.—City asks bids until December 14 on materials for power plant extension, equipment of all kinds. W. C. Shurger Engineering Co., engineer, Meridian, Miss.

McComb.—McComb and Magnolia Light and Railways Company which recently incorporated here with a capital of $500,000, (M. R. Walter, S. M. Jones and others), is contemplating the erection of a power plant in connection with interurban railway construction.

Pass Christian.—City is contemplating the erection of an electric light and power plant.

Utica.—City is planning the construction of an electric lighting plant. Xavier A. Kramer, Magnolia, Miss., engineer.

Wesson.—City council authorized issuance of $18,000 bonds to construct electric light plant and water works. M. L. Culley, Jackson, Miss., engineer.

MISSOURI

Bevier.—City has voted $12,000 bonds to establish an electric light plant.

Crane.—Company is reported being organized to construct electric light plant. Will secure electricity from Osark Power and Light Company, Ozark, Mo.

Gallatin.—City will improve electric light plant; construct power plant; install pumps, motors, etc.

Maplewood.—City Council has granted a franchise to Western Power and Light Company to operate electric light system here.

Milan.—City has authorized the construction of electric street lighting system.

Monett.—Ozark Power and Light Company, Ozark, Mo., has secured the franchise to distribute electricity and will contract to furnish electricity to City Commission.

New Madrid.—City Council has authorized the installation of additions to electric light plant here. H. H. Humphrey, St. Louis, engineer.

Plattsburg.—Plattsburg Water and Power Company has been chartered here with a capital stock of $12,500 by Joel Funkhouser, H. R. Riley and Edmond McWilliams.

Poplar Bluff.—City is constructing new brick poster house to cost $46,400. Fuller-Coult Co., engineers, St. Louis, Mo.

St. Joseph.—City Council has passed ordinance appropriating $5,000 for extensions to street lighting system.

Schell City.—E. T. Hartje, 2437 Independence Ave., Kansas City, Mo., has been granted a franchise to establish an electric light plant here. Plant to cost about $6,000.

Springfield.—It is reported that city will construct an electric light plant in the near future.

Steelville.—Steelville Electric Light and Power Company is planning the installation of an electric light plant to cost about $10,000.

NEW JERSEY.

Trenton.—The Public Service Electric Company has received permission to issue $3,000,000 of its capital stock. This will be devoted to plant extension.

NEW YORK

Buffalo.—The Buffalo General Electric Company, it is reported has options on fifty-four acres of land on the Niagara River outside of this city and is arranging to build a steam generating plant at a cost of $2 000 000.

Amsterdam.—The Edison Electric Light and Power Company is planning to issue $327,000 additional capital stock and $350 000 in first mortgage bonds. Most of this money, it is believed will be expended on plant and transmission line improvements.

Gowanda.—The Gowanda Light and Power Corporation has been incorporated here with a capital stock of $100,000, by G. M. Gest, Geo. A. Larkin and Edmond Wisnewski, of New York City.

New York City.—It is reported that a large power house will be constructed on the site of the old home of the New York Metal Exchange, which recently changed hands. The property fronts 174 feet on Burling Slip, 97 feet on Water Street, and 40 feet on Pearl Street.

New York City.—Chiriqui Electric Corporation; electrical and mechanical engineers, etc., has been incorporated with a capital stock of $150,000, by J. A. Stapleton, C. Jameson, F. R. Owen, 8-10 Bridge Street New York City.

NORTH CAROLINA

Burnsville.—Yancey Light and Power Company has been incorporated here with a capital stock of $125,000, by R. W. Eilson, E. F. Watson, Ben Fountain and others.

Cullohee.—Cullohee Telephone and Power Company has been chartered here with capital of $25,000, by A. C. Reynolds, The Brown Company and J. N. Wilson.

Durham.—The Durham Traction Company is expending $20,000 for improvements at its power house.

Elkin.—Chatham Manufacturing Company is planning the installation of an electric power plant here to operate local factories.

Gastonia.—City Council has appropriated $6,000 to construct white way system.

Hickory.—City is to advertise for bids for electric light and power franchise.

Jacksonville.—Jacksonville Electric Company has been incorporated here by L. M. Avery, Geo. A. Hurst and K. Avery; capital stock $10,000.

Lumberton.—City is rebuilding street lighting system; extends about 6 miles.

Salisbury.—Southern Power Company it is reported will enlarge substation and install additional equipment.

Stantonsburg.—City is constructing new electric light plant.

OHIO

Cincinnati.—The Rene-Kaether Electric Company has increased its capital stock from $15,000 to $25,000.

OKLAHOMA

Fairfax.—C. L. Huffaker has secured a 25-year franchise and will erect an electric light plant here.

Goltry.—Board of Trustees are planning the installation of an electric light plant and distributing system, Benham Engineering Company, Oklahoma City, is preparing plans.

Paden.—City is planning the installation of an electric light plant.

Shamrock.—Sapulpa and Oil Fields R. R., Springfield, Mo., is to install power station here in connection with electrification of oil field and railroad.

Stillwater.—Commissioners contemplate installing new generating equipment in municipal plant early in 1916.

Westville.—City has voted $10,000 bonds to purchase local electric light plant.

PENNSYLVANIA

Ellwood City.—The Mahoning and Shenango Railway has purchased the generating station here of the Pennsylvania Power Company, and will expend approximately $150,000 on improvements.

SOUTH CAROLINA

Gaffney.—It is reported that this city is to construct a white way system in the near future.

TENNESSEE

Camden.—Wade Powry and John D. Rice are constructing an electric plant to supply this town.

Mason.—Company is being organized to install an electric light plant for this city.

Camden.—Camden Electric Light Company has been organized here by J. D. Rice and Wade Lowry, to succeed former company and rebuild power house. Cost about $5,000.

TEXAS

Austen.—Austen Street Railway Company is to erect concrete and brick power house to cost about $5,000.

Beeville.—City is planning to install an electric light plant and water works.

Dallas.—Dallas Union Terminal Company is preparing plans for power plant to cost about $40,000.

Decatur.—City has issued $10,000 bonds for improvements to electric light and water plants.

Floresville.—Floresville Light and Power Company has been incorporated with a capital stock of $25,000 by B. J. Carrico, B. H. Martin and W. T. Pittman.

Forney.—Forney Water, Light and Ice Company has increased its capital stock from $20,000 to $25,000.

Houston.—Texas Gas and Electric Company has been incorporated here by C. L. Carter, W. A. Parish and R. Neilson; capital stock $1,000.

Lampasas.—Lampasas Light and Power Company; capital $8 000, incorporated by Emil F. Habey, T. S. Alexander and E. Haby, Sr.

Lockney.—Texas Utility Company organized by H. Wurdack, of St. Louis, Mo., and others has acquired electric light plants at Lockney, Lubbock and Plainview, also about 75 miles of transmission lines in Floyd, Neale and Lubbock counties. Will sell electricity to farmers, etc.

McKinney.—Texas Power and Light Company, Dallas, Texas, has purchased municipal electric light plant.

North Pleasanton.—North Pleasanton Ice and Electric Company, capital $80,000; incorporated by L. B. Myers, C. F. McDonald and Geo. S. Pearl.

Quannah.—City is planning extensions and improvements to power house.

Rio Grande City.—Rio Grande City Ice, Water and Light Company, capital stock $24,000; incorporated by R. H. Margo, Lino Perex and Rosendo Martinez.

San Angelo.—San Angelo Water, Light and Power Company is arranging for improvements to electric light plant and water works costing $50,000.

Sherman.—City is planning to expend $150,000 to improve electric light plant, water works, etc.

VIRGINIA

Atkins.—D. B. Musser is contemplating the installation of an electric light plant here.

Blackstone.—C. E. Wilson, Crewe, Va., has franchise to build electric light plant here.

Fenwick.—City is reported to be about to install electric light plant.

Hopewell.—Prince George Electric Company has a franchise to distribute electricity for light and power; will secure electricity from Petersburg and Appomattox Railway, Petersburg, Va., which will build substation.

Norfolk.—Vulcan Electric Corporation, capital $90,000, incorporated by G. S. Friebus, S. H. Tyler, and others.

Petersburg.—Virginia Psssenger and Power Company will supply electricity to operate Petersburg and Appomattox Railway's proposed electric railway from Petersburg to Hopewell.

Virsco.—Virsco Development Company is installing an electric light plant here.

Winchester.—City is contemplating the construction of an electric lighting system.

WEST VIRGINIA

Pennsboro.—Pennsboro Ice and Power Company; capital $25000; incorporated by H. E. Hopkins, of Pennsboro, and J. L. Horner, of Clarksburg, and others. Will erect $25,000 electric light and power plant.

Thurmond.—It is reported that the Mt. Hope Electric Power and Water Company, Mt. Hope, W. Va., will construct and operate electric light plant telephone and telegraph system, in this city.

ELECTRICAL AGE

THE NATIONAL JOURNAL OF

Electric Practice

Formerly ELECTRICAL ENGINEERING

Volume 47, No. 10
Ten Cents a Copy

OCTOBER, 1915

Published Monthly
Subscription $1.00

Yes, Sir! That's the Right Lamp!

"A man came along the other day and told me that my windows were badly lighted. I laughed at the idea. Why, I had installed a new lighting system as late as last summer!"

"Well, sir; he just took the lamp he had in his hand, and replaced one of the other lamps with it, and blessed if it didn't give more light than all the rest of the lamps together, at least it looked that way to me! And it was a whiter, better light, too!"

"You bet, I bought some! I told him to replace all the old lamps with the new ones. I want my window displays to exert their maximum drawing power—and they do, with these new 100-watt National MAZDA lamps."

Make your prospects talk that way by demonstrating the 100-watt National MAZDA lamps on their own premises.

NATIONAL MAZDA

The Way to Better Light

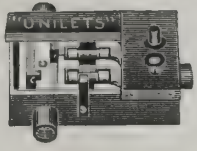
NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.

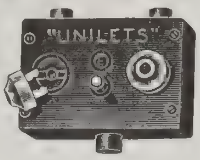
Nela Park, Cleveland

Member Society for Electrical Development: "DO IT ELECTRICALLY"

Drawn Steel

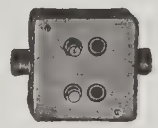
UNILETS





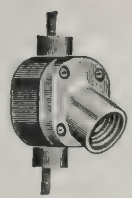
STEEL FITTINGS

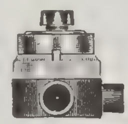
Something that will stand the wear and tear.
Something that will save 50% wiring space.
Something that is light in weight.
Something that is *neat*.



"UNILETS" are drawn from steel, are much lighter than cast iron fittings for the same size conduit, yet possess greater mechanical strength. Due to their thin wall construction they allow at least 50 per cent. more wiring space than other fittings of a similar type.

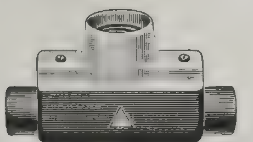
"UNILETS," because of their lightness in weight, are easier for the workmen to handle, and save considerable in transportation charges. Their durability is unsurpassed and being a steel fitting are not subject to breakage as are the brittle cast iron fittings.

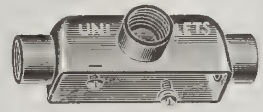




The conduit is steel, why not the fitting?

Copy of our latest catalog No. 7, also small booklet on "Unilets" sent upon request. Write us at once, addressing Dept. "E."





APPLETON ELECTRIC CO.

Main Office and Factory: 212-214 N. Jefferson St.

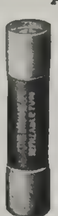
CHICAGO

EASTERN OFFICE
New York: 25 West Broadway

PACIFIC OFFICE
San Francisco: 680 Howard Street

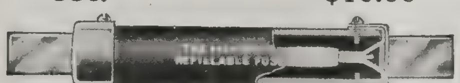
LOWEST PRICED REFILLABLE FUSE IS
"THE MONARCH"

Manufactured with all copper ends



ALL SIZES
30 Amperes
250 Volts
100 Blowouts
35c.

ALL TYPES
100 Blowouts of the ordinary non-refillable fuse.
$10.00

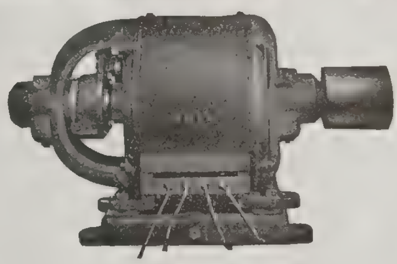


Money talks. Before ordering Refillable Fuses get our prices

MONARCH REFILLABLE FUSE CO., Inc.
1048 Jefferson St. **Buffalo, N. Y.**

BELL
Single Phase
MOTORS

MEET ALL REQUIREMENTS



Carried in stock by offices of Allis-Chalmers Mfg. Co.

Stock carried by the following representatives for immediate delivery

Westmore-Savage Co., 76 Pearl St., Boston, Mass.
Rumsey Electric Co., 1221 Arch St., Philadelphia, Pa.
Iron City Electric Co., 711 Grant St., Pittsburgh, Pa.
Barden Electric & Mchy. Co., Houston, Texas.
The Elliott Electric Co., Cleveland, Ohio.
Electrical Engineering Co., Minneapolis, Minn.
W. R. Ostrander Co., 22 Dey St., New York City.
Bell Electric Motor Co., 80 Church St., New York City.
James Clark, Jr., Electric Co., Louisville, Ky.
Electric Supply Company, New Orleans, La

First Class Supply Houses Wanted for Agents.

BELL ELECTRIC MOTOR CO., - - Garwood, N. J

HIGHEST AWARD—A GOLD MEDAL
was awarded to

DURADUCT

REG. U. S. PAT. OFF.

FLEXIBLE NON-METALLIC CONDUIT

At the

Panama-Pacific Exposition, San Francisco

Proving our statements that **DURADUCT** is Best—Always.

TUBULAR WOVEN FABRIC COMPANY
Manufacturers **PAWTUCKET, R. I.**

General Sales Agent, A. HALL BERRY
101 Warren St., NEW YORK **9 So. Clinton St., CHICAGO**
Distributors for Canada—NORTHERN ELECTRIC CO., Ltd.

HERWIG ART SHADE & LAMP CO.

"VENTILITE"

100% Efficient Holder for Type C Lamps
Made in sizes 6 to 10 inches

Cast Metal Outdoor Lighting Fixtures

Of Every Description

Write for complete Catalogue No. 10 and Bulletin on Nitrogen Lamp Holders

2142 HALSTED ST. **CHICAGO**

CUTTER SOL-LUX FIXTURES

Take a look up your business streets

The store front is an advertising medium which every merchant has available, but which he often overlooks.

A merchant's first thought in advertising should be to make his place of business advertise his business.

Electricity is the way, and SOL-LUX Lighting Fixtures are the means.

Every store, small or large, every movie, theatre, restaurant, delicatessen, garage, mill, factory, etc., in your community is a possible customer, if you'll go at them intelligently.

For completeness, variety, efficiency and artistic beauty, SOL-LUX Fixtures fill every requirement. For type C Mazda lamps we have evolved a line of fixtures which successfully solve the problems of efficient lighting, ventilation and glare.

Let us co-operate with you. Let us show you how to get this business. You'll profit by getting our latest catalog and samples of the popular units. For special requirements, the catalog will show just the fixtures needed to satisfy particular customers.

Write today for catalog and full information

George Cutter Company,

Main Office and Factory:

407 Notre Dame Street, South Bend, Ind.

CHICAGO
28 E. Jackson Blvd.

NEW YORK
30 Church Street

CUTTER SOL-LUX FIXTURES

For Big And Small Installations

Where low core loss and low temperature rise are desired

The more important work, the more real need there is for "Peerless" Transformers. Their remarkable efficiency and non-aging qualities insure permanent satisfaction. Core losses are reduced to the minimum. A trial will convince *you* of the advisability of carrying a stock of these justly famous

"Peerless" Transformers

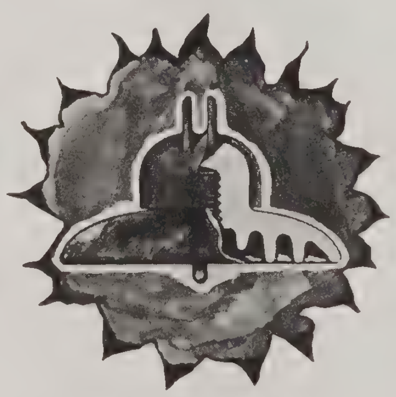
For Light and Power Service

All our Standard Transformers have balanced secondary winding for three-wire distribution. The non-aging cores are made of highest quality Silicon Steel. Central Stations will find it to their advantage to try "Peerless" Transfor. mers. Write *now* for our liberal proposition and guarantee-

The Enterprise Electric Co., Warren, Ohio, U. S. A.

AGENCIES:

National Electric Supply Co., Washington, D. C.
J. G. Schaff Electric Co., Chambersburg, Pa.
Baker-Joslyn Co., San Francisco, Cal.
James M. Cory, 50 Church St., New York City.
John McC. Price, Pittsburgh, Pa.
Price Electric Co., St. Paul, Minn.
Barden Electric & Machinery Co., Houston, Tex.



No. 1141

An Ideal Solution of the Insulator Problem

This splendid design aside from conveying all of the marked **"THOMAS"** features, presents new and inviting attractions.

The noticeable increase in the thickness of the porcelain has produced much greater strength, mechanically, and furthermore tends to give higher puncture value.

This Insulator measures ten inches in diameter across the porcelain and has a spacing of five and three-eighths inches. Weight twelve pounds.

Blue print and complete data upon request.

Suitable designs for all voltages.
Send for our No. 12 Catalog.

FACTORIES	The R. Thomas & Sons Co.	SALES OFFICES
E. Liverpool and Lisbon Ohio	Executive Offices East Liverpool, Ohio U. S. A.	61 Broadway New York Old Colony Bldg. Chicago, Ill.

You are cordially invited

to inspect the exhibit of STANDARD products at the P. P. I. E. when in San Francisco. It has been awarded a gold medal, or highest award in its class, in recognition of the completeness and superior quality of the line of electric wires, cables and cable accessories shown. If you are a buyer or user of such products you will be both interested and instructed. Do not fail to look us up in the Palace of Machinery.

A gold medal has also been awarded a small exhibit of Standard products at the San Diego, Cal., Exposition.

Standard Underground Cable Co.
Pittsburgh, Pa.

Boston, New York, Philadelphia, San Francisco, Chicago, St. Louis

Yager's Fluxes Make Perfect Joints.

The Perfect Flux for all kinds of work. First patented—First now in quality and service. Soldering Salts in brown bottles or sealed cans. Paste form in tins or tubes.

ALEX. R. BENSON COMPANY
Hudson, N. Y.

Kwik-lite
THE QUALITY FLASHLIGHT

Offer the
People in Your Town
SOMETHING NEW
SOMETHING BETTER
SOMETHING THEY WILL BUY

65 Attractive Styles and Finishes

GUARANTEED BATTERIES
MAZDA LAMPS
CATALOGUE ON REQUEST

DESIGNED WITH SKILL
BUILT BY EXPERTS

THE USONA MANUFACTURING CO., INC
1 Hudson St. New York City - 309 S. Clair St. Toledo, Ohio.

PERFORATED METALS
for
ALL PURPOSES
Such as

Cotton Seed Oil Mills	Ventilation
Cotton Gins	Electrical Devices
Phosphate Screens	Sugar, Flour and Rice Mills
Coal Screens	Surfacing for Sand Rolls

Send for Metal Sample Plate and Circular

ERDLE PERFORATING CO.
165 John Street
ROCHESTER, N. Y.

EVERY PIECE OF ORANGEBURG FIBRE CONDUIT

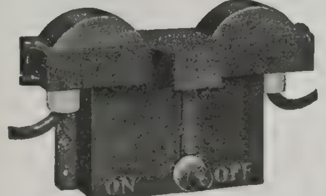
Is inspected before loading Send for Book "S"

Have you Samples?

THE FIBRE CONDUIT CO. Orangeburg. N. Y.
New York Boston Chicago San Francisco

HIGH TENSION WEATHER-PROOF OIL BREAK SWITCHES

For 3000, 4000, 5000 and 6000 Volt System—
Capacity 60 to 300 Amperes
Single Throw and Double Throw



SINGLE POLE

SEND FOR
BULLETIN No. 9

DOUBLE POLE

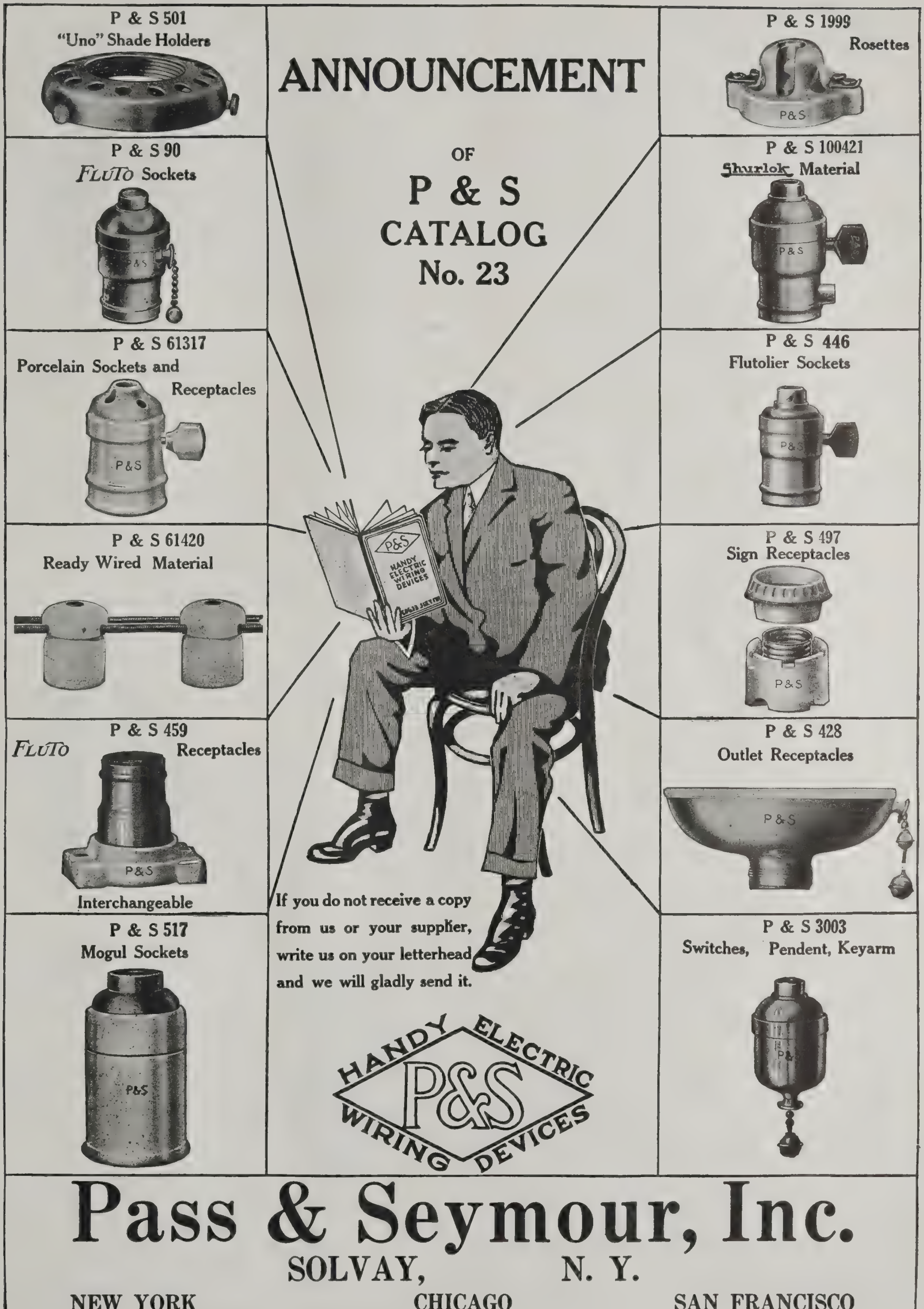
THREE POLE

FOUR POLE

CORRESPONDENCE
SOLICITED

HIGH TENSION ELECTRICAL SPECIALTY COMPANY - - NEWTON, MASS.


Western Electric
ONE GALLON
AJAX
U. S. STANDARD MEASURE
Insulating Material
BLACK ELASTIC BAKING INSULATING VARNISH
SAVE TIME AND FREIGHT
DYNAMOS-MOTORS WESTERN ELECTRIC COMPANY CABLE-TELEPHONES-SUPPLIES
FOR THE BEST INSULATING MATERIALS
GET IN TOUCH WITH OUR NEAREST HOUSE
SAVE TIME AND FREIGHT
Western Electric Company
DYNAMOS-MOTORS WESTERN ELECTRIC COMPANY CABLE-TELEPHONES-SUPPLIES
TELEPHONE OUR NEAREST HOUSE
New York Buffalo Newark Philadelphia Boston Pittsburgh
Atlanta Richmond Savannah New Orleans Houston St. Louis
Chicago Milwaukee Indianapolis Detroit Cleveland Cincinnati
Kansas City Omaha Oklahoma City Minneapolis St. Paul Dallas, Denver
San Francisco Oakland Los Angeles Seattle Portland Salt Lake City
MEMBER OF
SERVICE
THE SOCIETY FOR ELECTRICAL DEVELOPMENT INC NEW YORK
SAFETY
EQUIPMENT FOR EVERY ELECTRICAL NEED
"DO IT ELECTRICALLY"


P & S 501
"Uno" Shade Holders
P & S 90
FLUTO Sockets
P & S 61317
Porcelain Sockets and Receptacles
P & S 61420
Ready Wired Material
P & S 459
FLUTO Receptacles
Interchangeable
P & S 517
Mogul Sockets
ANNOUNCEMENT
OF
P & S
CATALOG
No. 23
If you do not receive a copy from us or your supplier, write us on your letterhead and we will gladly send it.
HANDY ELECTRIC
P&S
WIRING DEVICES
P & S 1999
Rosettes
P & S 100421
Shurlok Material
P & S 446
Flutolier Sockets
P & S 497
Sign Receptacles
P & S 428
Outlet Receptacles
P & S 3003
Switches, Pendent, Keyarm
Pass & Seymour, Inc.
SOLVAY, N. Y.
NEW YORK
CHICAGO
SAN FRANCISCO

Safety First

EXCELLENCE
MFC
RELIABILITY

Always Safety

Engineers are selecting the F. M. C. APPLIANCES on account of their DEPENDABILITY under the most severe SERVICE conditions.
F. M. C. Connections are of the HIGHEST CONDUCTIVITY. Once used, you will never use any other connector except F. M. C. CONNECTIONS.

Steel

Cable Grip

"A" Type, Class 4400

Cable Lug

"A" Type, Class 9800

Showing the compression, which makes a COLD WELD

The F. M. C. Cable Grip

The F. M. C. Cable Grip is compact and is exceptionally long lived. Slack can be taken up without trouble. Bending or cutting of strands is eliminated, exceptionally easy to install, one of the strongest cable grips on the market.

Write for catalogs and bulletins describing the complete line of electrical and mechanical connecting devices.

FARGO MANUFACTURING COMPANY, Inc.

Poughkeepsie, New York

JEFFERSON

The One Word That Is Synonymous With

LIGHT

The problem of greatest importance in building today is

LIGHT

The **JEFFERSON** engineers are at your service to offer suggestions and help you select the proper **LIGHTING** units that will give the **LIGHT** required and harmonize in color and design with the surroundings. After a selection is made the next questiou is shipment. We guarantee service—try us.

Write for a No. 30 Catalogue

TWO PIECE URN

of

DORIC DESIGN

Furnished in the following sizes:

No. 1250—5 inch
No. 1252—8 inch
No. 1254—12 inch

The **DORIC DESIGN** will readily lend itself to use with all styles of architecture, and can be had in—LANTERNS—URNS—SHADES—HEMISPHERES—BALL GLOBES or SEMI-INDIRECT DISHES.

JEFFERSON GLASS COMPANY

FOLLANSBEE, WEST VIRGINIA

NEW YORK CITY	BALTIMORE, MD.	CHICAGO, ILL.	KANSAS CITY, MO.	SAN FRANCISCO, CAL.
The Jefferson Glass Co.	The Jefferson Glass Co.	Tne Jefferson Glass Co.	The Jefferson Glass Co.	The Jefferson Glass Co.
L. W. Young	H. S. Bokee	A. W. Boulton	S. E. Wiedemer	Edwin B. Pike
Western Territory	121 West Baltimore Street	Michigan Boulevard Bldg.	705 West 32nd Street	Pacific Coast Territory.
220 East 42nd Street				215 RialtoBldg

Unconditionally Guaranteed

Your Transformers aren't giving the complete satisfaction you expected—are they?

You have been mulling over in your mind the advisability of getting some new ones—haven't you?

Kuhlman Transformers

have 20 years' manufacturing experience behind them.

These transformers are guaranteed—and we know absolutely that they are exactly what you want.

Our Transformer specialists are at your service. Let them study your problems and advise you. There is *no* obligation attached. Write us of your troubles. We can straighten them out.

Kuhlman Electric Co.

Bay City, Mich.

COMMUTATOR TROUBLES

AND THE SOLUTION

"No Spark" Carbon Brushes

——will eliminate sparking, heating and cutting,

——will permit your machine to run noiselessly and at maximum efficiency,

——will wear smooth, take on a high polish and produce a rich, chocolate brown gloss on the commutator,

——will reduce repair bills 90% and carry at least one-half more load than the brush you are now using.

ermanently self lubricated, with no chipping, breaking or sp itting.

Proof? Send for a trial set of brushes and use them 30 days without obligation. We know.

CALEBAUGH

Self-Lubricating Carbon Co., Inc.

1503 Columbia Avenue

Philadelphia, Pa.

Make Your Poles Last At Least 14 Years

Instead of putting up new poles every seven years, use Reeves Wood Preserver and double the life of your timbers. This wonderful fluid penetrates the wood and hardens there. Which keeps out the germs of moisture and decay.—Over 75% coal tar creosote.

Reeves Wood Preserver

REEVES TRADE MARK

is easy to apply—requires no heating or special apparatus. If quantity of work to be treated is large a cheap vat may be constructed.

Testing Outfit—Free

If you are interested in reducing the cost of construction and making timbers last longer, send for this outfit and see for yourself how the Preserver penetrates the wood, hardening there and keeping out moisture.

The Reeves Co., Mfrs. New Orleans

Treating Poles with Reeves Wood Preserver.

THE BUYERS ROAD SIGN

PIEDMONT ELECTRIC CO.

ELECTRICAL

QUALITY

PECO

SERVICE

SUPPLIES

ASHEVILLE, N. C.

THAT HELPS HIM ON HIS WAY

Classified Advertisements

The rate without display type for "Positions Wanted," "Help Wanted" and "For Sale" advertisements of 40 words or less is one dollar an insertion; additional words, two cents each, payable in advance. Remittances and copy intended for any issue should reach this office not later than the fifteenth of the month.

Replies may be sent care of ELECTRICAL ENGINEERING, Woolworth Building, New York.

POSITIONS WANTED

EXPERIENCED MECHANICAL AND CHEMICAL ENGINEER, with wide experience as assistant-manager and superintendent in several large manufacturing plants, is open for a connection with responsible concern, with opportunity to acquire part ownership through cash investment. Address T., care **Electrical Age**, 1642 Woolworth Bldg., New York.

OFFICE CLERK, with thorough experience with large concerns desires connection requiring trained sevices. Am a young man and willing to start at a nominal salary. Thos. Fangemann, 438A. Monroe St., Brooklyn, N. Y.

ELECTRICIAN with 14 years' experience installing high and low tension power-house equipment, motor drive in factories, transmission lines, etc. Good lineman and wireman. Capable of taking charge of installing plant. Finish present job in October. References. Box 114, Quincy, Fla.

DIRECTORY OF CONSULTING ENGINEERS ARCHITECTS and CONTRACTORS

BUYERS CLASSIFIED INDEX

Air Brakes.
Allis-Chalmers Mfg. Co.

Air Compressors.
Allis-Chalmers Mfg. Co.

Alarms.
Western Electric Co.

Ammeters and Voltmeters.
Duncan Electric Co.
General Electric Co.
Johns-Manville Co., H. W.
Norton Electrical Inst. Co.
Western Electric Co.
Westinghouse Eletrical & Mfg. Co.
Weston Electrical Inst. Co.

Anchors—Guy.
Barnes & Kobert Mfg. Co.

Annunciators.
Connecticut Tel. & Elec. Co.
Western Electric Co.

Armatures—Repaired.
Chattanooga Armature Works.
Oliver Electric & Machine Co.

Asbestos—Wood.
Johns-Manville Co., H. W.

Automoibles—Electric.
General Motors Truck Co.
General Vehicle Co.

Battery Chargers.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Batteries—Dry.
Carroll Elec. Co., The
Central Tel. & Elec. Co.
Johns-Manville Co., H. W.
Piedmont Elec. Co.
Southern Electric Co.
Western Electric Co.

Batteries—Primary.
Western Elec. Co.

Bells.
Carroll Electric Co.
Connecticut Tel. & Elec. Co.
Piedmont Electric Co.
Southern Electric Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.

Bonds and Stocks.
Electric Bond & Share Co.

Boosters.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Boxes—Cutout.
Adam Electric Co., Frank.
Columbia Metal Box Co.
Electric Operations Co., Inc.

Boxes—Fuse.
D. & W. Fuse Co.
General Electric Co.
Johns-Manville, H. W.

Boxes—Meter.
Adam Electric Co., Frank.
Hart Mfg. Co.

Boxes—Outlet and Junction.
Adam Electric Co., Frank.
Chicago Fuse Mfg. Co.
Columbia Metal Box Co.
Cutter Co., The George.
D. & W. Fuse Co.
Fibre Conduit Co.
Johns Manville Co., H. W.
National Metal Molding Co.
Pass & Seymour, Inc.
Raymond Elec. & Mfg. Co.
Steel City Elec. Co.

Boxes—Meters and Service.
Johns-Manville Co., H. W.

Brushes — Motors and Generators.
Calebaugh-Block Self Lubricating Carbon Co., Inc.
Dixon Crucible Co., Jos.

Brushes—Metallic.
Calebaugh-Block Self Lubricating Carobn Co., Inc.

Bushings.
Fibre Conduit Co.
Locke, Fred M.
National Metal Molding Co.

Bus Bar Covers.
Fibre Conduit Co.

Bus Bar Connectors.
Elec'l Engrs. Equip. Co.
Fargo Mfg. Co.

Bus Bar Supports.
Delta-Star Elec. Co.
Elec. Engineers Equip. Co.

Cabinets.
Frank Adam Electric Co.
Columbia Metal Box Co.
Electric Operations Co., Inc.
Trumbull-Vanderpoel Elec. Mfg. Co.

Cable—Aerial Power—(See Wires and Cables.)

Cable—Insulated.
Okonite Co., The

Cable—Steel Taped.
Simplex Wire & Cable Co.

Cable—Submarine and Lead-Covered.
Hazard Mfg. Co.
Indiana Rubber & Insulated Wire Co.
Moore, Alfred F.
Okonite Co., The
Rome Wire Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.

Cable—Telephone.
(See Wires and Cables.)

Cable—Underground.
Fibre Conduit Co.
Okonite Co., The

Cable End Bells.
Cope, T. J.
Elec. Engineers' Equip. Co.

Cable Junction Boxes.
Standard Underground Cable Co.

Cable Racks.
Barnes & Kobert Mfg. Co.
Cope, T. J.

Car Heaters—Electric.
Simplex Elect. Heating Co.

Carbons—Arc Light.
Calebaugh-Block Self Lubricating Carbon Co., Inc.

Carbons—Battery.
Calebaugh-Block Self Lubricating Carbon Co., Inc.

Carbons—Brushes.
Calebaugh-Block Self Lubricating Carbon Co., Inc.
Dixon Crucible Co., Jos.

Chandeliers.
Carroll Electric Co.
Piedmont Electric Co.
Johns-Manville Co., H. W.

Circuit Breakers.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Cleats.
Blake Signal & Mfg. Co.
National Metal Molding Co.
Thomas & Sons, R.

Coils—Armature and Field.
Chattanooga Armature Works.
D. & W. Fuse Co.
Nashville Armature Works.
Oliver Electric & Machine Co.

Coils—Choke.
General Electric Co.

Coils—Induction.
Western Electric Co.

Coils—Spark.
Western Electric Co.

Compounds—Boiler.
Dixon Crucible Co., Joseph.

Compounds—Commutator.
Calebaugh-Block Self Lubricating Carbon Co., Inc.

Condensers.
Allis-Chalmers Mfg. Co.
Westinghouse Elect. & Mfg. Co.

Conductors—Armored.
National Metal Molding Co.

Conduit—Bends.
Fibre Conduit Co.

Conduit Fittings.
Electrical Eng. Equip. Co.
Fibre Conduit Co.
National Metal Molding Co.
Western Conduit Co.

Conduit—Flexible.
American Circular Loom Co.
American Conduit Mfg. Co.
National Metal Molding Co.
Tubular Woven Fabric Co.

Conduit—Interior.
American Circular Loom Co.
American Conduit Mfg. Co.
Fibre Conduit Co.
National Metal Molding Co.
Tubular Woven Fabric o.
Western Conduit Co.

Conduit—Rigid.
American Circular Loom Co.
Enameled Metals Co.
Gest, G. M.
Johns-Manville Co., H. W.
National Metal Molding Co.
Western Conduit Co.

Conduit Rods—
Cope, T. J.

Conduit—Underground.
Fibre Conduit Co.
Gest, G. M.
Johns-Manville, Co., H. W.

Connectors and Terminals.
Cope, T. J.
Electrical Engineers Equipment Co.
Fargo Mfg. Co.
Steel City Elec. Co.

Construction Material.
Carroll Electric Co.
Central Tel. & Elec. Co.
Southern Electric Co.

Controllers.
Allis-Chalmers Mfg. Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Cooking Apparatus—Electrical. (See Heating Apparatus—Electrical.)

Cords.
Moore, Alfred F.
Samson Cordage Works.
Standard Underground Cable Co.

Cord—Arc Lamp.
Samson Cordage Works.

Cord—Flexible.
American Elect. Works.
Carroll Electric Co.
Marion Insulated Wire & Rubber Co.
Okonite Co., The
Samson Cordage Works.
Southern Electric Co.
Simplex Wire & Cable Co.

Cord—Telephone.
Moore, Alfred F.
Simplex Wire & Cable Co.

Cord, Trolley.
Samson Cordage Works.

Crane Motors.
Westinghouse Elec. & Mfg. Co.

Cross-Arms.
Southern Exchange Co., The
Thomas & Co., R.
Western Electric Co.

Cut-Outs.
Brady Elec. & Mfg. Co.
D & W Fuse Co.
General Electric Co.

Cut-Outs—Automatic.
General Electric Co.

Door Openers.
Newark Electric Supply Co.

Drills—Electric.
Clark, Jas. Jr., Elec. Co., Inc.
Stow Mfg. Co.

Drills—Portable.
Clark Elec. Co., Inc., Jas. Jr.
Stow Mfg. Co.

Dynamos and Motors (Second-Hand.)
Atlanta Electric Machine Co.
Oliver Electrc & Machine Co.
Nashville Armature Works.

Electric Fixtures.
Adam Electric Co., Frank
Carroll Electric Co.
Illuminating Engineering Co.
Piedmont Electric Co.
Raymond Elec. & Mfg. Co.
Southern Electric Co.

Electric Light Plants—Small.
Main Elec. Co.
Schug Elec. Mfg. Co.

Electric Signs—(See Signs).

Electric Sign Flashers—(See Flashers—Electric Sign).

Electric Vehicles.
General Motor Truck Co.
General Vehicle Co., Inc.

Engines—Gas and Gasoline.
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Mach. Co.

Engines—Steam.
Allis-Chalmers Mfg. Co.
Westinghouse Mach. Co.

Engineers—Consulting.
Arnold Co., The
Barrett & Fisher.
Byllesby, H. M. & Co.
Cooper, Hugh L. & Co.
Dixon-Smith Engineering Co.
Fryer, Roy C.
Jackson, D. C. and Wm. B.
Pillsbury, Chas. L.
Sanderson & Porter.
Spiker, William C.
Stone & Webster Engineering Corporation.
White & Co., J. G.

Fans—Exhaust.
Diehl Mfg. Co.
Peerless Electric Co.
Robbins & Meyers Co.
Southern Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co

Fan Motors.
Carroll Elec. Co., The
Clark, Jas. Jr., Elec. Co., Inc.
Colonial Fan & Motor Co.
Eck Dynamo & Motor Co.
General Electric Co.
Matthews Elec. Co.
Peerless Electric Co.
Piedmont Elec. Co.
Robbins & Myers Co.
Southern Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Fibres.
Fibre Conduit Co.
Johns-Manville Co., H. W.
Standard Underground Cable Co.

Filtration Engineering.
Kirkpatrick, Walter G.

Financial.
Electric Bond & Share Co.

Fire Extinguishers.
Johns-Manville Co., H. W.
Pyrene Mfg. Co.

Fixtures—Lighting.
Adam Electric Co., Frank
Carroll Electric Co.
Cutter Co., George
Illuminating Engineering Co.
Johns-Manville Co., H. W.
National Electrical Supply Co.
Raymond Elec. & Mfg. Co.
Southern Electric Co.
Wallace Novelty Co.

Flashlights.
Carroll Electric Co.
Piedmont Elec. Co.

Friction Tape and Cloths.
Johns-Manville Co., H. W.
Okonite Co., The
Walpole Tire and Rubber Co.

BUYERS CLASSIFIED INDEX---Continued

BUYERS CLASSIFIED INDEX---Continued

Sockets—Turndown.
General Electric Co.

Soldering Irons.
Simplex Electric Heating Co.
Westinghouse Elec. & Mfg. Co.

Soldering Material.
Alex R. Benson Co.
Blake Signal & Mfg. Co.
Johns-Manville Co., H. W.

Solenoids.
General Electric Co.

Stage Lighting Apparatus.
General Electric Co.
Johns-Manville Co., H. W.

Staples—Insulating.
American Steel & Wire Co.
Blake Signal & Mfg. Co.

Starters and Controllers—Motor.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Steel Armored Wire.
Okonite Co., The

Stocks and Bonds.
Electric Bond & Share Co.

Stoves—Electric—(See Heating Apparatus—Electrical).

Strainers—Perforated.
Erdle Perforating Co.

Substations—Outdoor.
General Electric Co.

Supplies—Electrical.
Carroll Elec. Co.
Clark, Jas. Jr., Elec. Co., Inc.
Cutter Co., The
Delta-Star Elec. Co.
Electrical Engineers' Equipment Co.
General Electric Co.
Hart Mfg. Co.
Johns-Manville Co., H. W.
National Elect. Supply Co.
National Metal Molding Co.
Peerless Electric Co.
Piedmont Elec. Co.
Rutkin, M.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Supplies—Telephone.
Carroll Elec. Co.
Johns-Manville Co., H. W.
Piedmont Elec. Co.
Southern Electric Co.
Western Elec. Co.

Switchboard Supplies.
Electrical Engineers' Equipment Co.
General Electric Co.

Switchboards—Light and Power.
Frank Adam Electric Co.
Allis-Chalmers Mfg. Co.
Central Tel. & Elec. Co.
General Electric Co.
Trumbull Elect. Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switchboards — Telephone — (See Telephone Equipment).

Switches—Automatic Pump.

Switches—Flush and Snap.
Carroll Elec. Co.
Hart Mfg. Co.
National Metal Molding Co.
Newark Electric Supply Co.
Pass & Seymour, Inc.
Piedmont Elec. Co.
Trumbull Elect. Mfg. Co.
Southern Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches—Fuse.
General Electric Co.

Switches—Knife.
Adam Elec. Co., Frank.
General Electric Co.
Piedmont Elec. Co.
Trumbull Elec. & Mfg. Co.
Trumbull-Vanderpoel Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches—Oil.
General Electric Co.
High Tension Elec. Spec. Co.
Westinghouse Elec. & Mfg. Co.

Switches—Pendant.
Carroll Elec. Co.
Hart Mfg. Co.
Piedmont Elec. Co.
Southern Electric Co.

Switches—Pole Top.
Delta-Star Elec. Co.
Electrical Engineers' Equipment Co.
General Electric Co.

Switches—Remote Control.
General Electric Co.

Switches—Time.
Campbell Elec. Co.

Tape.
American Electrical Works.
Johns-Manville Co., H. W.
Newark Electric Supply Co.
Okonite Co., The
Standard Underground Cable Co.
Walpole Tire & Rubber Co.

Telephones — Intercommunicating—(See Telephone Equipment.

Telephone Equipment.
Connecticut Tel. & Elec. Co.
Western Elec. Co.

Terminals—Cable.
Cope, T. J.
Elect. Engineers' Equip. Co.
Standard Underground Cable Co.

Testing Apparatus.
Bristol Co.
Thompson Levering Co.

Testing—Electrical.
Electrical Testing Laboratories.
National Elec. Laboratories.

Theater Dimmers.
General Electric Co.

Toggle Bolts.
Cutter Co., George.

Tools—Linemen's.
Western Elec. Co.

Transformers.
Allis-Chalmers Mfg. Co.
Columbia Metal Box Co.
Duncan Electric Mfg. Co.
Enterprise Electric Co.
General Electric Co.
Kuhlman Electric Co.
Moloney Electric Co.
Piedmont Elec. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Inst. Co.

Transformers—Bell Ringing.
Carroll Elec. Co.
Piedmont Elec. Co.
Southern Electric Co.
Westinghouse Elec. & Mfg. Co.

Turbines—Steam.
Allis-Chalmers Mfg. Co.
General Electric Co.
Leffel & Co., James.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Vacuum Ceaners.
Western Elec. Co.

Vehicles—Electric.
General Motors Truck Co.
General Vehicle Co., Inc.

Ventilators.
Erdle Perforating Co.

Washing Machines—Electric.
Western Elec. Co.

Washers—Iron and Steel.
Erdle Perforating Co.

Water Heaters—Electric.
Simplex Electric Heating Co.

Water Wheels and Turbines.
Allis-Chalmers Mfg. Co.
Leffel & Co., James.

Wattmeters—(See Instruments—Electrical).

Wire-Resistance.
Driver-Harris Wire Co.

Wires & Cables.
American Electrical Works.
American Platinum Works.
American Steel & Wire Co.
Carroll Elec. Co.
D. & W. Fuse Co.
Detroit Insulated Wire Co.
Driver-Harris Wire Co.
General Electric Co.
Hazard Mfg. Co.
Indiana Rubber & Insulated Wire Co.
Lowell Ins. Wire Co.
Moore, Alfred F.
Okonite Co., The
Piedmont Electric Co.
Roebling's Sons Co., John A.
Phillips Insulated Wire Co.
Rome Wire Co.
Southern Electric Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.
Western Elec. Co.

INDEX TO ADVERTISERS


WESTINGHOUSE MAZDA LAMPS
WESTINGHOUSE MAZDA C LAMPS
Westinghouse Mazda Advertising
Before you pay your next light bill Consider
FACTORY
THE ELECTRIC JOURNAL
TEXTILE WORLD RECORD
Electrical World
ELECTRIC RAILWAY JOURNAL
PREST-O-LITE
ELECTRICAL ENGINEERING
ELECTRICAL MERCHANDISE AND SELLING ELECTRICITY
JOURNAL OF ELECTRICITY
NATIONAL ENGINEER
ASK AND YOU SHALL RECEIVE THIS VALUABLE BOOK
Southwestern Electrician
American Machinist
Railway Age Gazette
ELECTRICAL REVIEW
RAILWAY ELECTRICAL ENGINEER
The Central Station
Lighting Journal
Our Part
There's a big increase in lamp business waiting for those of us who will go out after it and get it.
Effective advertising, intensive sales effort and close cooperation between manufacturer and distributer will produce the increase.
We are ready to do our part. Our advertising and selling service is as complete as we can make it. Our sales representatives are capable men who can offer valuable advice and assistance on sales campaigns.
Your part is an important one. The opportunity is yours. Will you take advantage of it?
We can help you if you let us. Our assistance can be had for the asking.
Westinghouse Lamp Company
Atlanta
Baltimore
Boston
Buffalo
Butte
Chicago
Cincinnati
Cleveland
Dallas
Denver
Detroit
Kansas City
Los Angeles
Milwaukee
New Orleans
New York
Philadelphia
Pittsburgh
Portland
St. Louis
Salt Lake City
San Francisco
Seattle
Syracuse
Export Sales Dept., 165 Broadway, New York City
Member Society for Electrical Development
DO IT ELECTRICALLY

TRANSFORMERS

Manufactured for all electrical purposes in any size, frequency or voltage.

Lighting and Power Transformers
High Transmission Transformers
Single and 3-Phase Transformers

To secure prices give us K. W. capacity voltage, cycles, transformers required.

MOLONEY ELECTRIC CO.

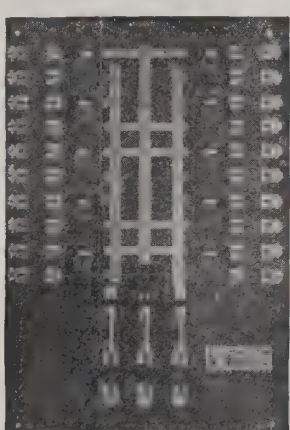
St. Louis, Mo. **Windsor, Canada**

District Offices: New York – Chicago – San Francisco.

THE NEW, COMPLETE LINE OF

T-V Knife Switches and Panelboards

Standard Panelboards



Type F, Fuses in Mains

Described in the new T-V Catalog

All Styles and Sizes

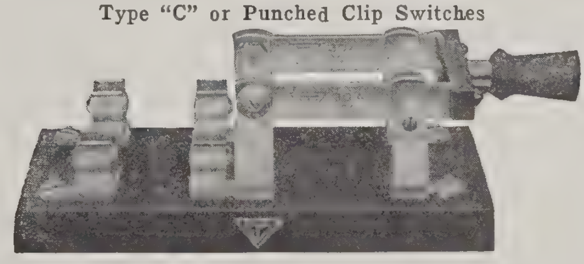
For

All Conditions

of

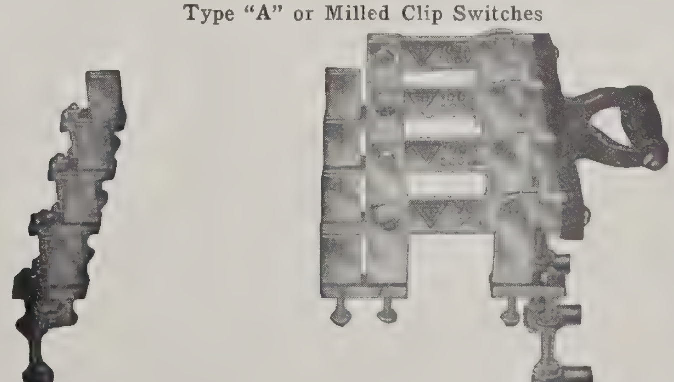
Service

Type "C" or Punched Clip Switches



Single to Four Pole for N. E. C. Fuses, High Fingers, 250 Volts, A. C. or D. C.

Type "A" or Milled Clip Switches



500 Volts, A. C., Three and Four Pole, for N. E. C. Fuses High Fingers, Fused Bottom.

You will find the new T-V catalog mighty helpful in selecting the right knife switches panelboards, switchboard cabinets, etc.

A Marginal Thumb Index of the catalog enables you to turn immediately to the pages listing the article you are at the moment interested in.

Convenient, complete and helpful—write for a copy.

The Trumbull-Vanderpoel Electric Mfg. Company,

Bantam, Connecticut

New York Chicago Boston Philadelphia